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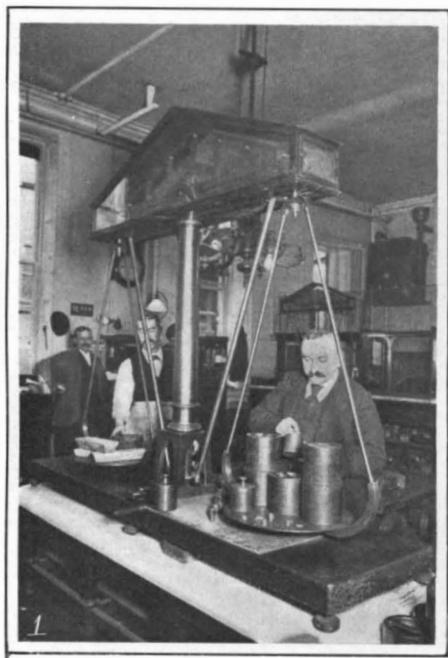
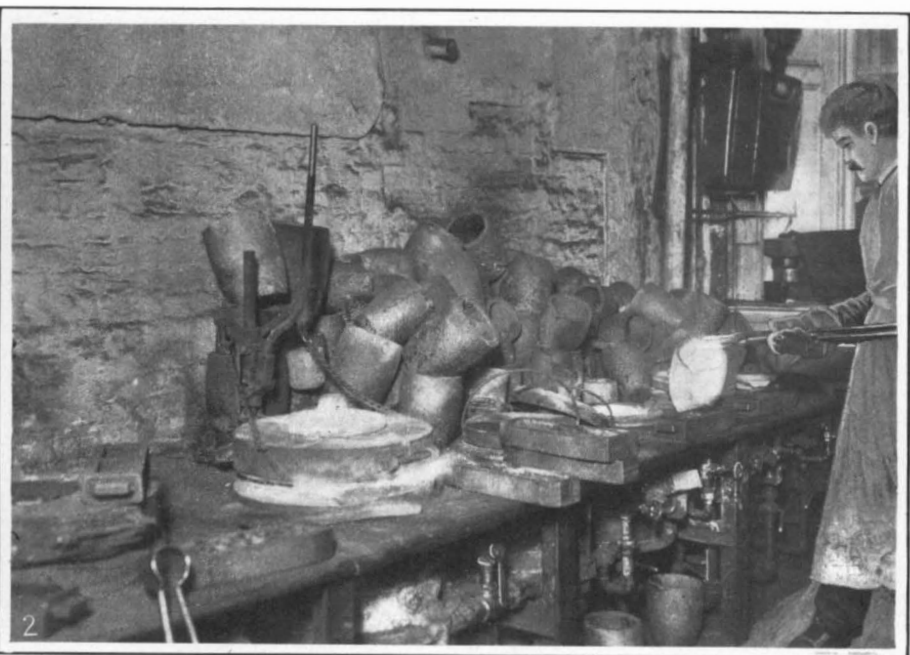
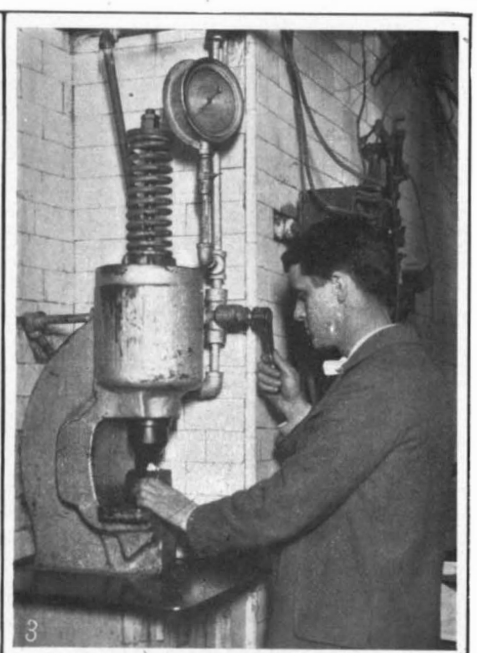
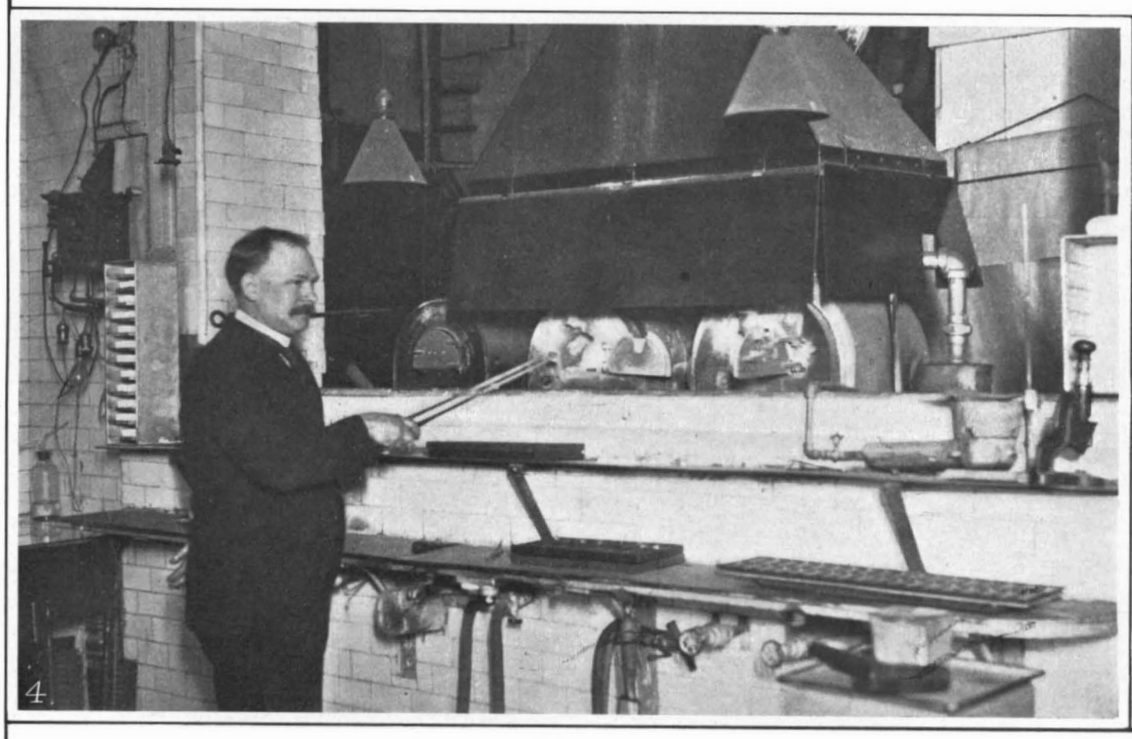
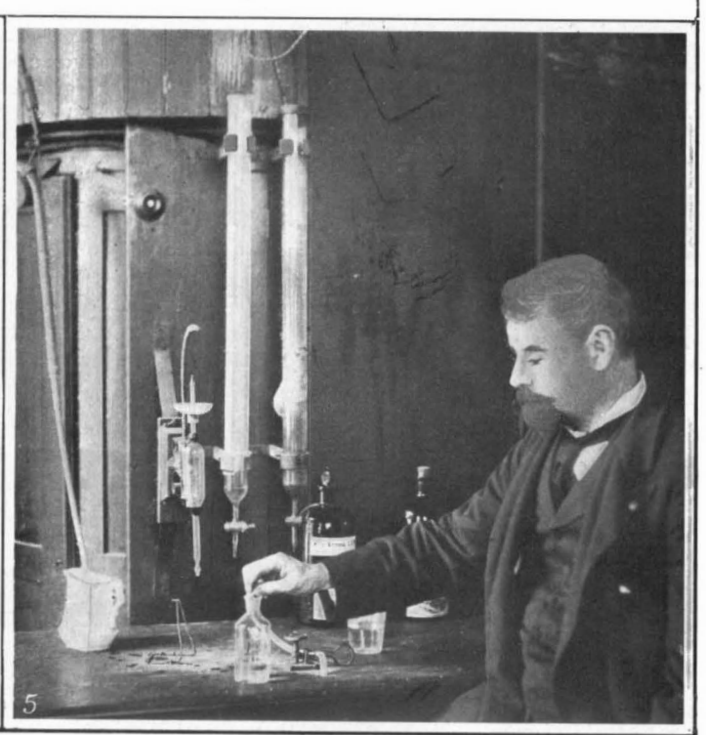
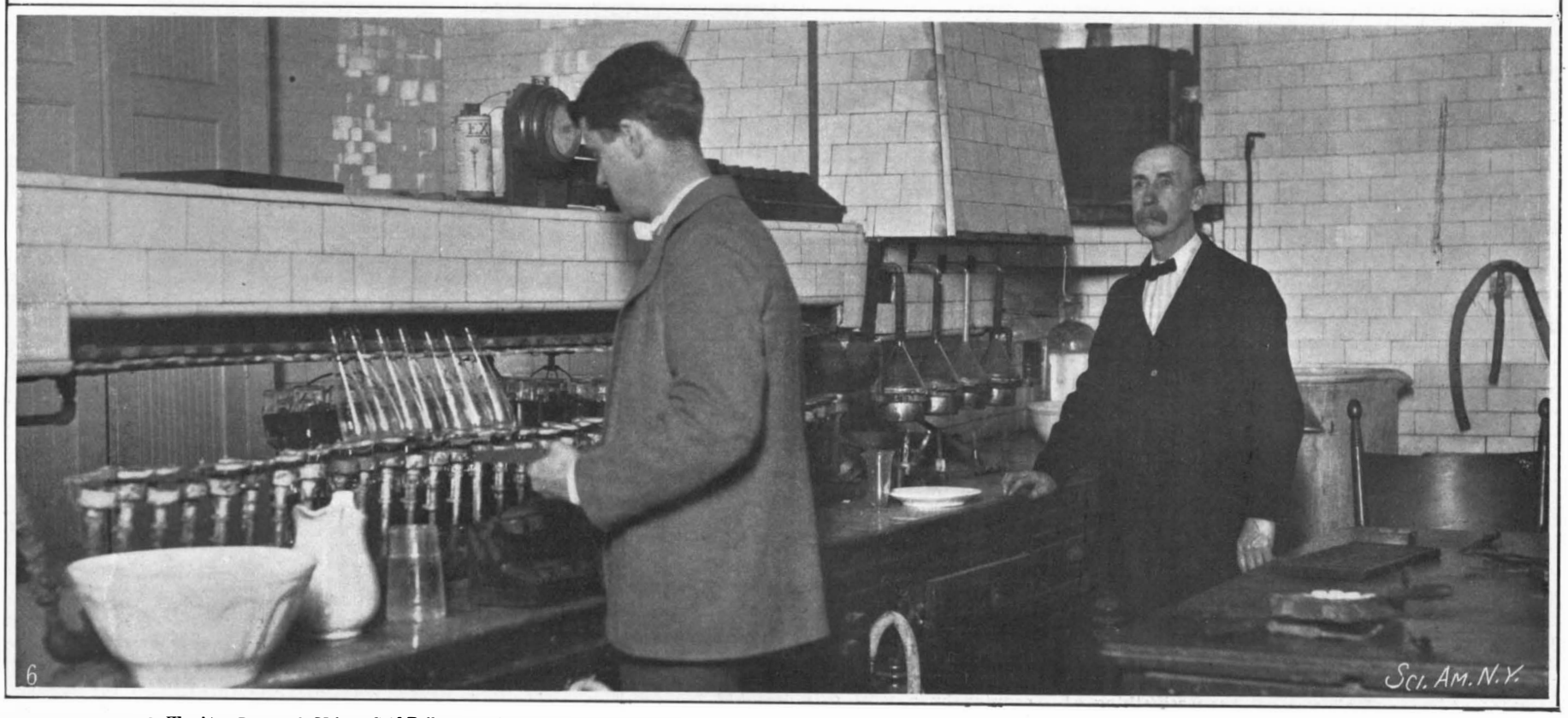






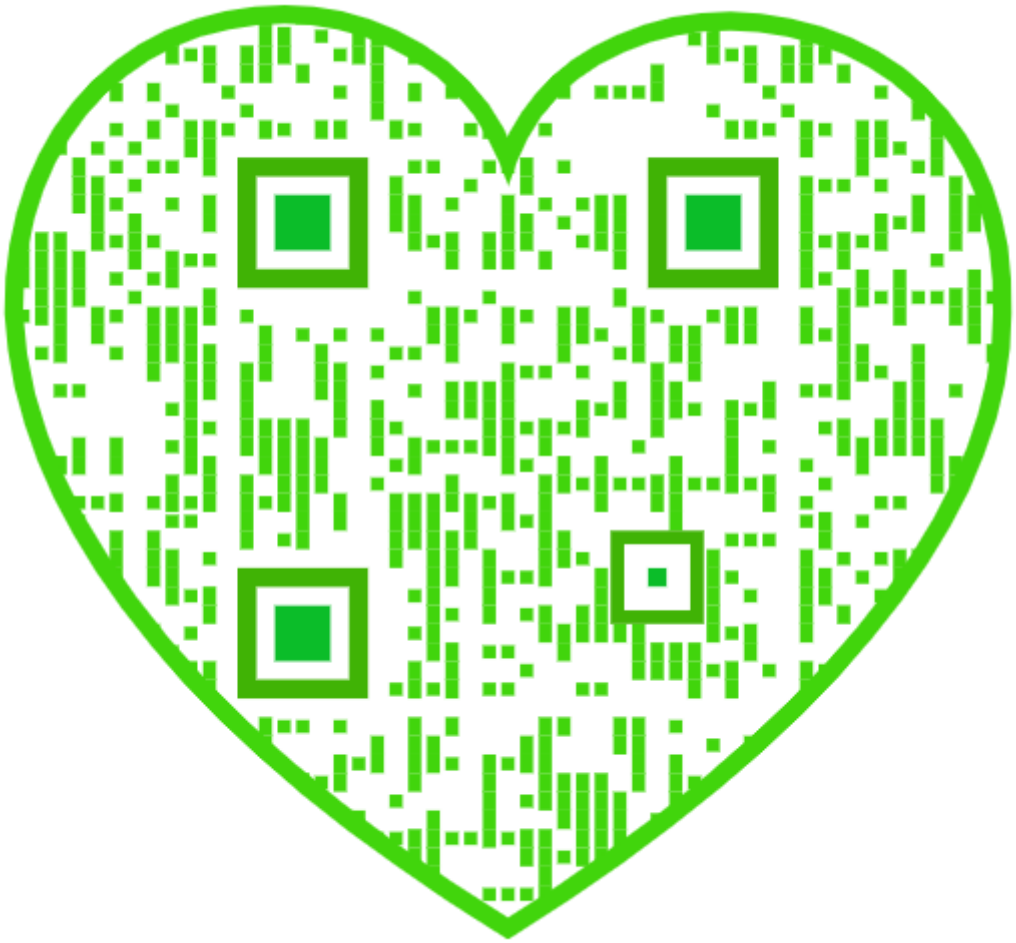






1. Weighing Room. 2. Melting Gold Bullion. 3. Pressing the Assay Sample. 4. Muffle Furnaces for Fire Assay. 5. Humid Assay for Silver. 6. Extracting the Silver with Boiling Acid.

ASSAYING GOLD AND SILVER BULLION AT THE NEW YORK ASSAY OFFICE.—[See page 107.]



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NEW YORK, SATURDAY, FEBRUARY 15, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

POSSIBILITIES OF A STEEL PANIC.

Of all our industries the manufacture of steel affords, perhaps, the most striking evidence of the unrivaled run of prosperity that the country is now enjoying. In spite of the fact that our production, both of pig iron and finished steel, greatly exceeds that of any other country in the world, the demand of the home market is such that it has overtaken our production, and even gives promise of exceeding it. One of the leading officials of the largest bridge company in this country considers indeed that we may shortly be confronted with a steel famine of serious proportions. So greatly has the home demand increased, that no contracts are being made for export, and importations from abroad are looked upon as inevitable. As illustrating the condition of affairs, the case may be mentioned of an important southern road which has been unable to secure delivery of a much-needed order for 25,000 tons of steel rails, and in consequence is now driven to the consideration of the question of immediately importing 10,000 tons from abroad. It has been customary to speak of the recent remarkable development of our export trade as the overflow of an industrial development which had exceeded the demands of the home market. We very much doubt if the ablest prophets of finance ever expected to see the day when the enormous and rapidly-increasing output of our steel industry would be overtaken by the demand for home consumption.

GERMANY'S EXPORT TRADE IN HER HOUR OF NEED.

Apropos of the question of export trade, we notice that in a report to the State Department on the business depression of Germany, by Consul-General Frank H. Mason, attention is drawn to the fact that it is to her splendid export trade that Germany owes her salvation during the period of financial depression through which she is passing. Mr. Mason would have American manufacturers keep this fact carefully in view. Says the Report: "If there is in the history of the present crisis in Germany one definite, pertinent, object lesson for the study of other nations—especially the United States—it is the manner in which many of its industrial commercial interests have been sustained and carried through this period of stagnant and inert local markets by a well-established and skillfully supported export trade. During the years of her prosperity Germany had laid the foundations of her foreign commerce broad and deep. She has trained her young men for efficient commercial service in foreign lands, has subsidized new steamship lines, and has sent her ships, bearing not only her manufactured goods, but her banking capital, her engineers, and her constructors, to the remote regions of the earth. The reward of all this wise foresight and careful preparation has already come." During the recent awful depression in which some of the oldest and most wealthy banking institutions and industrial corporations have suffered shipwreck, the extensive export trade of the country has been remarkably steady and shows, indeed, to-day signs of an increase. Foreign orders have served to keep going many an industrial establishment which, had Germany possessed only a home market, would have had to close its doors. As regards our own export trade, and especially that major portion of it which has been developed during the past three or four years, it must be admitted that in its inception it consisted largely of overflow production, and that its very existence may therefore be regarded as, in a sense, accidental. Hence there is a valuable lesson to be learnt from the experience of Germany as to the steadying effect of a well-established export trade. If, as a nation, we lay that lesson to heart, we shall make redoubled efforts, and efforts that have something of the German system and persistency in them, to cover new territory and strengthen our hold upon that which we have already entered.

DOUBLE-DECKING THE BROOKLYN BRIDGE.

After so many years of positive ineptitude on the part of the officials who were supposed to look after the interests of the Brooklyn Bridge, it is decidedly refreshing to note the very practical way in which Bridge Commissioner Lindenthal is taking hold of the very serious problem presented by the overcrowded condition of the Brooklyn Bridge. While the motive of his attempt to divert a portion of the traffic from that thoroughfare to the ferries is commendable, nobody knows better than himself that it is only a temporary expedient, or one from which we can look for only a temporary relief. The Bridge is frightfully overcrowded, and thanks to the incompetence or indifference, or both, of the late Bridge Commissioners, and the altogether inexcusable dilatoriness of the firm that is building the cables, there is no likelihood of any diversion of a portion of the Brooklyn Bridge travel to the new bridge for two or three years to come. And even when the new structure is opened, the Brooklyn Bridge is likely to be about as crowded as ever, for the reason that the increase in the volume of travel within the interim is likely to be as large as, or larger than that portion of the traffic now passing over the Brooklyn Bridge, that will seek the new East River Bridge. Hence we think it is altogether advisable to consider at once the question of the enlargement and strengthening of the Brooklyn Bridge. The proposal which has been made to double-deck the Bridge is quite practicable, for the reason that the additional load imposed could be taken care of by four supplemental cables lying above the present cables and in the same vertical plane. The towers are the one portion of the Bridge that can carry considerably more than its present load without any strengthening; and it would be a simple matter to add, if necessary, to the weight of the anchorages by building an additional mass of masonry. The provision of trolley tracks on an upper deck of the Bridge would necessitate a loop at the level of the present overhead foot-passenger platforms. This would probably involve some rather costly structural alterations at either terminal, as the present headroom would be insufficient. The cost and inconvenience would have to be faced, for the whole bridge problem has reached a stage at which it is a case of "needs must when the Devil drives."

THE TORPEDO-BOAT FIASCO.

In our last issue we described the great difficulty which the British builders are having in getting out of the latest torpedo boats the guaranteed speed; this week we have to record the fact that American builders are having trouble of the same kind and, if anything, more of it. In both cases the difficulty is due to the tendency to sacrifice strength in this class of vessels to speed. The "speed craze" of which we hear so much just now is no mere fiction. Not merely in the design of torpedo-boats, but in the largest battleships and armored cruisers there has been a disposition of late years to exaggerate the importance of speed. Admiralty boards, boards on construction, and naval designers in general, have been adding knot to knot, and in the case of the "Novik" class of cruisers in the Russian navy, the speed has been raised no less than five knots at a single jump.

All warship design is a matter of compromise, and it is inevitable that where so much weight is put into motive power, a corresponding amount of weight has to be deducted from some other elements of the design. Not even the steadily-increasing size of the modern warship, whether in the torpedo-boat or battleship class, has been able to stave off the inevitable reduction of weights in elements of the ship, other than those which conduce to high speed. Generally speaking, it is the accommodations and conveniences necessary to the adequate berthing and comfort of the ship's crew that have suffered. When it has not been these, the structure of the vessel itself has been called upon to pay the "pound of flesh," and scantlings have been cut down to a limit, which recent events have shown to be altogether impractical.

While there has been no visible evidence of a reduction of structural strength in the larger vessels, except where they have chanced to touch bottom, or run afoul of each other, or ventured to train the larger guns across the deck, as was possible in some of the older ships like the "Texas," on which the main battery was arranged *en echelon;* in the smaller types, and particularly in the torpedo-boat class, the lack of structural strength has produced unending trouble and occasional disaster. Hulls have been lightened and engine weights increased, until in the case of a boat like the "Cobra" we have engines of the indicated horse power of an ocean liner, carried within the frail shell of a craft of only 450 tons displacement.

The torpedo-boat question has been revived in this country by a most extraordinary request which has been made to the Navy Department by the builders of the torpedo boats and torpedo-boat destroyers which are now under contract for the navy. These boats have been so costly in construction that, with few exceptions, they have proved a loss, and in some cases a very heavy loss, to the contractors, who have therefore petitioned the Secretary of the Navy for additional payments, that will amount to an increase of over 40 per cent of the price named in the contract. As a commentary upon this curious condition of things, it should be mentioned that the bids for the construction of these boats were so low that the department, at the time the tenders were made, gave warning to the contractors that they would probably lose money on their contracts. Already two of the firms concerned have failed, and it begins to look as though the holding of the other builders strictly to the terms of their contracts might in some cases precipitate further disaster.

The Board reports that of the sixteen torpedo-boat destroyers, it is not likely that any one will attain the minimum speed which is necessary for acceptance, and that "not one of them is likely to be an entirely satisfactory vessel." This is news indeed. It will produce a sting of disappointment and chagrin throughout the country for which the public is but little prepared. Those who are conversant with naval matters, and who follow the development of our new ships with any attention, have been aware that the builders, both of torpedo boats and of torpedo-boat destroyers, have been having considerable difficulty in securing the contract speeds; but we must confess that we had no idea that these troubles were any greater than those that ordinarily attend the acceptance trials of torpedo craft. It begins to look as though in this matter of torpedo-boat construction, as in that of some other special lines, such for instance as the construction of automobiles, it is necessary that the builder should have behind him years of practical experience and a whole mass of slowly acquired data, before he can hope to turn out a really first class product. In Europe the only torpedo-boat builders that seem to be able to accept a contract with absolute certainty that they can live up to it, are those whose establishments are as old as the industry, and who, like Yarrow and Thornycroft in Great Britain and Normand in France, have twenty or thirty years' experience to go upon. Evidently this is the view of the question which is taken by our Naval Board, which says: "The building of successful torpedo vessels having the 'highest practical speed' is an occupation that requires designing talents of a high order and prolonged experience in construction. There are comparatively few successful builders of torpedo vessels in the world, but the attempt was made in this country to rival the best results obtained abroad with designs which were not based on the known results of a large number of previous vessels, and by builders whose knowledge and experience were of a limited character."

One lesson of the recent failure, both here and abroad, is that too much has been attempted. It is doubtful, we had almost said certain, that in the practical uses of war these sensational speeds of 27 to 35 knots will never be approached nor even attempted. If the destroyer were made about 50 per cent larger, her displacement being raised to say 600 tons; if her scantlings were strengthened to a point at which the craft would be able to stand the stress of hard driving even in a nasty jump of a sea; and if the trial speed conditions were to consist of a six hours' run at a full speed of 25 knots, the torpedo fleets of the future would be staunch, fast under service conditions, and thoroughly serviceable, neither of which qualities can be claimed for them under existing conditions.

RECLAIMING OUR COAST LANDS.

Holland presents the best example of a nation's attempt to reclaim valuable land from the sea, and France and England have followed suit in some notable instances; but the United States has, by virtue of its extensive coast line, possibilities and promises in this direction that must eventually eclipse anything heretofore attempted in Europe. Public and private interests are being awakened to the necessity of reclaiming coast marshes and in shutting out the sea permanently from beaches which offer excellent building sites for summer homes. The fact that coast marshes harbor and breed mosquitoes and poisonous fever germs is another reason for developing the lands so that such nuisances will be forever abolished. Tidal swamps and salt marshes are numerous all along the Atlantic and Pacific coasts, and their value as farming land has been repeatedly demonstrated, and their reclamation is a matter of great monetary importance, fully as much as the irrigation of the semi-arid lands of the West.

If at the same time the mosquitoes and malarial germs which lurk in these marshes could be abolished, the reclamation of the low, worthless seacoast property would prove of inestimable value to all who reside near the sea or go down to it for summer vacations. The investigations of the Department of Agriculture have been conducted for years with special reference to reclaiming the marshes economically and

permanently. As the low fens of England have been reclaimed to the extent of some 1,000,000 acres, it is believed that several times that amount of land along our two coasts can be converted into good farming land at an expense much less than that required to irrigate the semi-arid plains of the West. Agricultural engineers all along the coast have studied the problems presented, and in several instances private companies have undertaken the work of saving the salt meadows for farming purposes.

Closely allied to this subject is that of saving from the sea, land already formed and in excellent condition for building or farming purposes. The encroachment of the sea upon the land is steady and disastrous at many places along the coast, washing away valuable beaches and farming land during every heavy storm. So uncertain is this constant destruction of the coast that great engineering feats have been attempted in the past to protect the land. Lighthouses have had to be moved repeatedly on beaches threatened by the tides and currents, and valuable seashore property has been undermined and tumbled into the ocean until whole summer communities have been ruined. Breakwaters and other protective means have been constructed at great expense, but often without satisfactory results.

Ten years ago the Department of Agriculture decided that investigations on this subject should be made along a line that was somewhat novel to many. It was felt that grasses were the most effective agencies for shutting out the sea. Sand-binding grasses could hold the beaches in compact forms so that even the waves of the ocean could not break through the barrier. At Provincetown, on Cape Cod, the first most effective experiments were made with sand-binding grasses. These were planted to hold the drifting sands in place, and where the plants became thoroughly established, both the winds and waves were rendered powerless in moving the fine sands. Beach and sand-binding grasses are now being planted from Maine to Florida by private and public means, and they are gradually forming a compact, continuous barrier to the sea, which will be shut out for all time. The sand-storms of Cape Cod and Cape Hatteras are gradually being eliminated, and the beaches will change less and less as the roots of the grass spread.

In establishing permanent bulwarks against the encroaching sea, the government has provided working plans which all private property owners can adopt and follow. The first step is to convert the sea into a land-building instead of a land-destroying agent. This is accomplished by utilizing the tides and currents in depositing floating sand at desirable points. Hedgerows of brush and spiles are built out into the sea at right angles to the currents and tides. These when deflected sharply to one side, deposit the floating sand particles in the acute angle thus formed, or if the water flows over the barrier the bushes and twigs catch great quantities of the loose sand and gradually build up a sandbar, and then a beach.

Whole beaches have not only been saved in this way, but new ones built up at little expense. The government has repeatedly saved valuable lighthouses from the sea by this simple method. When the beach is finally raised above the tide mark, sand-binding grasses are planted on it. These become established in time, and the powerful roots of the plants bind the land into a compact mass which can resist almost any power of the waves and tides. The whole coast is thus gradually being transformed and protected, and seaside property thus becomes of more permanent value than in the past.

A NEW POLAR EXPEDITION.

Another attempt to reach the North Pole is to be made by Capt. Joseph E. Bernier, a Canadian sea captain, who is at present in London completing his arrangements for the expedition. Capt. Bernier had prolonged experience of the Arctic seas and their peculiar characteristics while commander of a sailing vessel. He has followed with interest the movements of all expeditions having for their object the discovery of the North Pole. For six years he has been raising funds for the purpose of equipping an expedition of his own, and has received financial assistance to carry out his plans from a number of prominent men.

Capt. Bernier anticipates that his effort to reach the North Pole will occupy at least four years. His ship will be allowed to drift for three winters and two summers. By that time he expects to be within 100 to 150 miles from the Pole, and a final dash will then be made to cross the ice.

Capt. Bernier has prepared plans for a steel-sheathed ship, somewhat similar to the "Fram" used by Nansen, but possessing greater sail and steam power. She will be 120 feet long, 36 feet beam, and 18 feet deep. The vessel will be provided with a flush deck, and will be fitted with many modern appliances not hitherto possessed by Arctic explorers. The ship will be heated partly by electricity and partly by steam. A distilling apparatus will be carried, so that pure water will be always assured, and two electric stoves for cooking purposes will also be provided to maintain the vessel in an absolutely dry condition, for dampness is one of the greatest enemies of the Arctic explorer.

The ship will be equipped with a complete system of telephones, so that communication between the wheelhouses, engine-room, crow's nest and cabins will always be possible.

A telescopic pole is to be fitted to the mainmast, to enable it to be raised to a height of 200 feet if necessary, so as to permit of communication between the ship and parties on shore by wireless telegraphy. Capt. Bernier thinks by this means it will be possible for him to maintain communication with Dawson City, Alaska, during the first winter in the ice, and the second year he will endeavor to communicate with the world by wireless telegraphy to either Dawson City or Hammerfest, which latter port will then be 1,200 miles distant. In view of the fact that, according to several experiments that have been made from time to time, ether communication of this description is more easily maintained in a lower and cold temperature, Capt. Bernier should experience little difficulty in this direction.

The expedition will set out from Vancouver, on the Pacific coast, before July 1, 1903, so as to reach a point sufficiently far north by the arrival of the winter. The vessel will shape her course for Bay St. Lawrence, and will call at Port Clarence, to which port supplies will be sent ahead by a schooner.

Port Clarence will be the last port of call. The expedition will spend the first winter in the ice about 150 miles north of Point Barrow. Then in the spring the vessel will drift to a point about 150 miles distant from the Pole. As the expedition proceeds northward on this drifting voyage stations will be established, with food supplies, at intermediate points. The men sent out from the ship for this purpose will keep in communication with Capt. Bernier by wireless telegraphy.

For the final dash to the Pole, which Capt. Bernier will make across the ice, he intends to use two specially designed five horse power motor cars, each capable of holding 2,000 pounds. The motors are so designed that if the exigency arises they can be quickly converted into boats, each holding several persons.

Food stations will be established at mile intervals after Capt. Bernier leaves the ship, the food being intended for the return journey to the vessel. It will consist of condensed foods packed in cylinders, and each cylinder marked by a flag, so that its position can be readily detected. Dogs will also be taken on the journey across the ice from the ship to the Pole.

Fresh provisions for the party while drifting northward will be taken by Capt. Bernier in the shape of lambs, pigs and other live stock. The expedition will carry a balloon for the purpose of observing the condition of the ice far ahead, and likewise kites for aerial photography.

Capt. Bernier will provide for every emergency, and a man desiring to join the expedition must be prepared to stay at least four years in the North. A crew of fourteen men will be taken. The vessel will be equipped with two windmills, placed near the port and starboard lights respectively, to furnish power for heat and light. One of the windmills will also be connected with a pumping apparatus for keeping the ship clear of water when necessary.

NEW SALT OF GLUCINIUM.

Messrs. Urbain and Lacome have lately discovered a new volatile salt of glucinium which presents some remarkable properties. When the hydrate of glucinium is dissolved in dilute acetic acid and the solution evaporated in a water-bath, a mass of gummy consistency is obtained. This substance presents none of the characteristics of a definite compound, although it has been supposed to contain a basic salt. If this mass is treated with concentrated and boiling acetic acid, a solution is obtained which upon cooling gives in the first place a deposit of crystalline needles, and then, at a lower temperature, of octahedral crystals of a well-defined form, which finally remain alone. This new compound is insoluble in cold water, but boiling water dissolves and also decomposes it. It is but slightly soluble in alcohol and nearly insoluble in ether. It dissolves in concentrated acetic acid when hot, but at 17 deg. C. there remains scarcely one per cent in solution. Chloroform is by far the best solvent, and takes up a large proportion. At a temperature of 284 deg. C. this body melts to a colorless and mobile liquid. It distills without decomposing at the normal pressure at 331 deg., and its vapor may be heated as high as 360 deg. in presence of air without undergoing alteration. This property enabled the experimenters to determine its vapor density at the temperature of boiling mercury by Meyer's method, and they obtained for result D = 13.9. This figure corresponds to a molecular weight of 401. As the atomicity of glucinium is a disputed point, the new compound may throw some light on the question. Its molecular weight and analysis lead to the formula $[CH_2CO_3]_6$ $Gl_4O = 406$, admitting $Gl = 9$ and $GlO = 25$. It is impossible to conciliate the composition of the body and its vapor density by supposing $Gl = 13.5$ and $Gl_2O_3 = 77$. This result gives a new argument in favor of the diatomicity of glucinium. If the physical properties of this body are singular, one of its chemical properties is not less so, for this basic salt is formed in a solution which is extremely acid. Besides, in dissolving the body in concentrated acetic acid saturated with gaseous hydrochloric acid, the salt did not undergo any alteration, although it was heated for several hours in sealed tubes at 150 deg. C. It must be concluded that in this compound the basic function of the glucina is masked. The authors are carrying out further experiments on the subject.

SCIENCE NOTES.

The town of Molsen, Wash., recently went into bankruptcy and finally into the hands of a receiver. It is now in charge of a trustee.

The President of the Jersey City Board of Health has decided that the city hospital is so infected with disease germs that it should be burned, the sanitary conditions being so bad that it is impossible to remedy them.

A cinematograph picture has been taken of the Severn bore. It is believed that this is the first moving picture of a tidal bore. The film is 150 feet long and contains 2,400 individual pictures. About half the length is devoted to the bore itself, and the remainder shows the rapid current which follows and the filling up of the river.

The Police Board of Jersey City, N. J., have decided that a bronze cross shall be given to policemen who distinguish themselves by the arrest of desperate criminals, saving life or for any other cause which shows their courage and faithfulness. The cross is to be suspended from a bar which is to be inscribed "The Bronze Cross." In the center of the cross will be a representation of a policeman's shield. A certificate will be given to the man with the cross. For any flagrant violation of the rules the cross can be taken away.

In the High School in Sioux City, Iowa, the School Board has undertaken what is proving to be a very successful experiment in serving hot lunch to the pupils at cheap prices, says The Municipal Journal. A lunch room has been fitted up, and there the scholars can purchase many hot dishes at minimum rates. Everything is sold for checks, which can be obtained in lots of ten and twenty-five cents' worth. Much time is saved in this way, and it is possible to serve ninety boys and girls in ten minutes. A woman runs it for the Board, and is allowed to make a little out of it. Everything is clean and the food of the best.

Sir W. H. Preece, formerly chief electrician to the British Post Office, has been engaged for some time past upon a study of the magnetic influences upon the compass of the Manacles Rocks off the coast of Cornwall, and upon which the steamships "Mohegan" and "Paris" were wrecked. Sir William Preece states as the results of his investigation that if any navigator sets his course from Cherbourg to the Lizard without knowing the variation of the magnet that has occurred during the last five or six years he would run upon the Manacles. The variation was bringing the needle nearer to the North Pole, and in ten years it varied a whole degree. The difference of a degree in a magnet signified an error of one mile in a course of sixty miles, so that unless the captain's observations were maintained with all accuracy and care, if the Admiralty did not correct their charts from time to time, and if captains of ships did not make themselves acquainted with these different errors, then sooner or later disaster was certain to occur.

M. Santos-Dumont, upon his reception in England by the newly-founded Aero Club of Great Britain, discussed his forthcoming experiments with his new airship that is in course of building for use in 1902. It will be the seventh and largest machine he has yet employed. It will be fitted with two petrol motors of forty-five horse power each, as compared with the sixteen horse power motor of the previous vessel. At present he has decided to carry out his experiments upon the lines in which he has been so successful. It is his contention in connection with navigable balloons that aeroplanes should not be used. M. Santos-Dumont thinks that petrol will be the sole power employed for aerial traffic, since with a petrol motor half the motive power is derived from the air, thus minimizing the weight of fuel to be carried. Electric and other motors must carry all motive power in bulk. The outer balloon of No. 7 will be cigar-shaped as before, but it will have two inner cases instead of one. There will be no framework inside, the material being kept rigid solely by pressure. M. Dumont intends continuing his experiments with machines with a carrying capacity of one person only for the present.

MAIL TRANSPORTATION IN CITIES.

BY WALDON FAWCETT.

The best methods to be employed to secure a speedy and economical movement of the mails in the larger cities is a problem which has received and is receiving an immense amount of attention from the officials of the United States Post Office Department. Thoroughly revolutionary influences have been at work in this field of late years, and as a result there has been in progress an almost continuous evolution of the utilities employed. Comparatively a short time ago branch post offices were practically unknown outside the very largest cities, and the pouches of mail matter were transferred to and from railroad trains in wagons which did not represent particularly rapid transit, even were there not taken into consideration the ever-present danger of delays from congested street traffic. Now every city of any size enjoys the advantages of sub-stations for postal distribution, and electric cars, pneumatic tubes and automobiles are displacing the old-fashioned vehicles in the transportation field.

This transformation is, of course, a gradual one. For instance, there are yet in existence in cities something over two hundred wagon routes for carrying mail pouches between the sub-stations and the main post office, or the main office and railroad stations and *vice versa*, but there are also in operation close to three hundred electric and cable car routes which perform the same service. In several cities it has been found possible to so arrange the electric-car mail routes as to entirely discontinue wagon service, the cars not only covering all that had previously been done by wagons, including the carrying of the mails to and from railroad stations, but also furnish supply for a number of newly established mail stations.

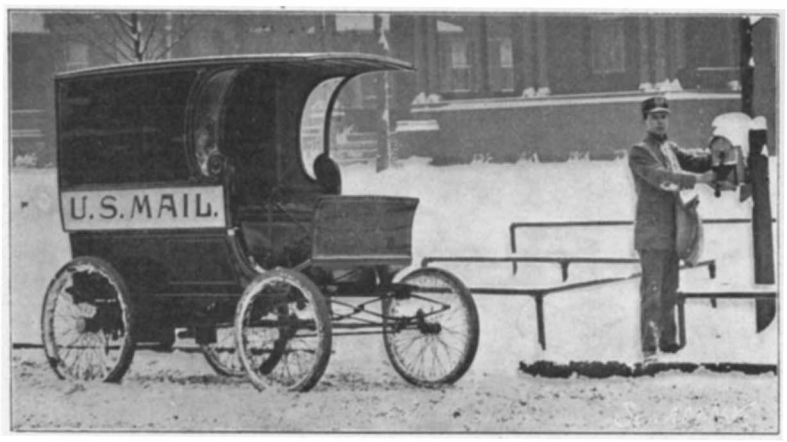
It is the hope of the postal officials to ultimately be enabled to entirely dispense with the wagon service, which in addition to being slow is decidedly expensive as compared with the more modern system. To indicate this conclusively and convincingly, it may be noted that the latest statistics prepared by the Post Office Department show that the average cost per mile traveled by the wagons is over 16 cents, whereas the cost for the electric and cable car service averages less than 6 cents per mile traveled. Computing the cost of each service for a full year on the basis of the aggregate length of each class of routes, it is found that whereas the wagon service has entailed an expenditure of $481 per mile of length, the outlay for electric or cable car service was only $143 per mile.

In some cities the plan has been followed of attaching a letter box to the guard on the forward platform of the street cars in the postal service; and when any citizen living on the route desires to mail a letter it is only necessary to signal a car and deposit the letter in the box. In the cities where this plan has been introduced letters move more rapidly from the writer to the mail-train than anywhere else in the world.

However, the great mission of mail cars on the electric lines and elevated railroads is to afford quick communication between sub-stations and the main post office. How extensive is this system of branch post offices will be appreciated when it is stated that there are in New York city about two dozen sub-stations, in Boston about twenty, in Chicago approximately the same number, and in San Francisco eight, the other large cities being supplied with proportionate liberality.

The rapid growth of American cities and the expansion of the territory covered by free delivery, as well as the distance of many of the postal stations from steam-railway stations, has greatly complicated the whole problem of delivering mail by carrier as well as its transportation in bulk. It was to promote the efficiency of both branches of the service that the scheme of sub-stations was introduced, and the department is now seeking to still further expedite the handling of mail matter in the larger cities by urging business people and all large patrons of the postal service to have printed upon their envelopes and stationery the number of the carrier, or, if the addressee lives outside the delivery of the central office, the branch office or station from which he is supplied.

Judged from any standpoint, one of the most important utilities in suburban mail transportation is found in the pneumatic service, now unfortunately discontinued. The utilization of large tubes for the transmission of mail matter has heretofore been largely of an experimental nature, but the investigation which the government has been conducting as to the cost of construction, operation and utility of these systems has concluded with favorable results, and an effort will be made to secure heavy Congressional appropriations each year until the pneumatic mail delivery service has been fully installed in large cities.



AUTOMOBILE MAIL VAN.

The automobile also, as a factor in city mail transportation, is scarcely past the experimental stage. Thus far it has been introduced principally for collection purposes. The initial introduction of the automobile in postal service in this country was made at Buffalo, where an electric phaeton of one ton weight made a run from the main office to a sub-station in nineteen minutes, the return trip consuming but eighteen minutes. Following this speed test a collection trial was made, and 150 pounds of mail collected from twenty-two regulation boxes and eight package boxes in thirty-three minutes.

The first trial with an automobile manufactured especially for mail collection purposes was made in Cleveland some months later. The route selected was twenty-two miles in length, and mail was collected from 120 boxes. Under ordinary conditions a collector with horse and wagon required exactly six hours to cover this territory, but the automobile made the circuit in two hours and twenty-seven minutes, and this under the most unfavorable circumstances, since a fierce snowstorm was raging almost the entire time. In Detroit a carrier's route that ordinarily requires two hours and thirteen minutes for collection was covered by an automobile in one hour and eight minutes. Several manufacturers are now working upon motor vehicles designed expressly and exclusively for postal service, and the postal officials express full confidence in the universal use of the horseless vehicles as soon as there have been evolved autos which can be depended upon to travel over all kinds of roads, in all kinds of weather, and invariably prove vastly superior in speed and safety to the wagons and carts drawn by horses, which are now employed in the free delivery service in cities.

SORTING MAIL EN ROUTE ON A TROLLEY CAR.

AUTOMOBILE TROLLEY MAIL CAR IN BOSTON.

Enormous Personal Injury Damages.

The annual report of the Brooklyn Rapid Transit Company, just issued, shows that the enormous sum of $971,867 was paid during the year on claims for personal injuries, says the Railway Review. The legal and claim department expenses swelled this amount to $1,142,962—or nearly 10 per cent of the company's gross receipts. The report says: "A large part of these excessive payments is unjustly exacted. So low has the standard of professional ethics fallen, that to-day it is common to see attorneys, physicians, clients and witnesses leagued in a conspiracy to mulct railroad companies, manufacturers and merchants, each of the parties to the conspiracy having a contingent interest in the verdict and being tempted by the hope of success to exaggerate injuries, pervert facts and corrupt jurors. It used to be illegal, and has always been deemed improper, for an attorney to have a contingent interest in the result of his litigation, but it is not too much to say that not 50 per cent of the money which your company paid last year in damages through attorneys reached their clients."

Burial of Soldiers.

Instructions have recently been issued by the War Department to insure uniform sanitary methods for the burial of the remains of soldiers dying outside the limits of the United States, and to facilitate their subsequent disinterment for removal to this country for final burial, says the Medical Record. For this purpose, wooden coffins are used, having holes bored in the bottom to facilitate the escape of fluids. The remains are clad for burial in ordinary clothing, and the space remaining in the coffin is filled with freshly burned lime. As it is desirable that the soft parts shall disintegrate as rapidly as possible, the use of hermetically sealed metallic coffins is discouraged. The remains of soldiers who have died of contagious disease are wrapped in sheets wet with corrosive sublimate solution or formalin and buried without coffins in graves packed with lime, the bodies being covered to a depth of six inches with the same material. On disinterment for return to the United States, the remains, usually left undisturbed for a year after burial, are at once wrapped in sheets wet with a disinfectant solution. The remains of each soldier are then placed in a metallic casket with a movable top which is tightly clamped down against a rubber gasket, previously thickly coated with white lead. An air-tight joint is thus formed. The casket is then inclosed in a stout box for shipment, being packed around with sawdust to prevent injury to, or movement of, the casket. During the first fiscal year, the remains of 1,825 officers, soldiers, sailors, and civilians have in this way been returned from the West Indies and the Pacific Islands, and given honorable burial in the United States.

One of the first reforms to which the new city administration of New York is devoting itself is the introduction of an adequate street sign system in New York. For four years, or since the Strong administration went out of power, this apparently small matter, which is really important to so many people, was persistently neglected.

HOME-MADE ELECTRIC NIGHT LAMP.

BY GEORGE M. HOPKINS.

A very simple device, which will produce a temporary light of one-half of one candle power, is shown in the illustration. It will be found convenient for observing the time at night, or for momentarily lighting a closet or an area where the light of a candle or an oil lamp would be objectionable.

The miniature electric lamp, and the dry batteries used for lighting it, can be purchased almost anywhere, and the labor of putting these things together, with a switch and suitable connections, is very slight indeed. A one-half candle lamp requiring 1.58 amperes at 2.5 volts is the first requisite; then two cells of dry battery, giving a current with a pressure of about 3 volts will be needed, and last of all a small packing box, that will just receive the batteries, should be selected. If a lamp of higher voltage is chosen, more cells of battery will be needed. A 4-volt lamp will require three cells of battery. A little more light will be secured with this combination, but it is not desirable to increase the number of cells beyond this, as the apparatus becomes at once too bulky and too expensive. The best combination is the one-half candle lamp with two cells of battery. After the lamp

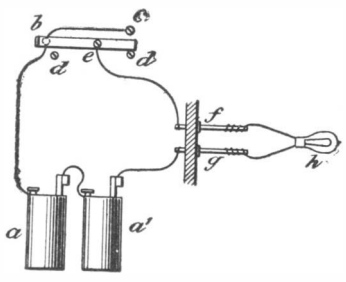
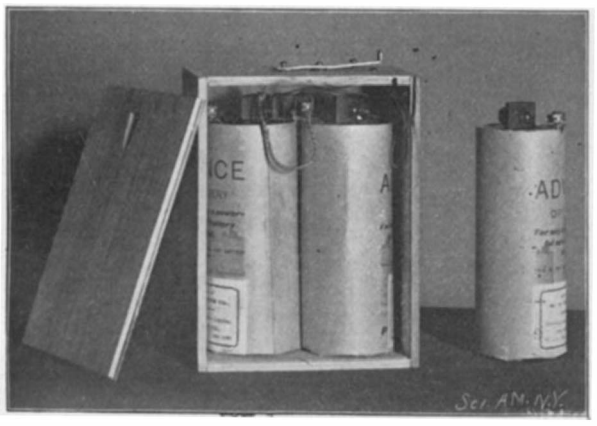
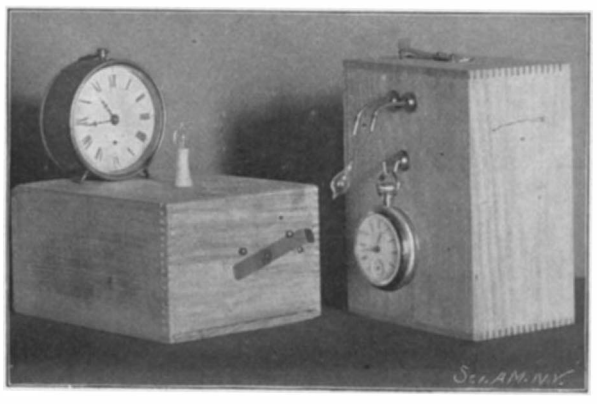


DIAGRAM OF CIRCUIT.



BATTERY-BOX, COVER REMOVED.



TEMPORARY LIGHT.

is procured it should be tested momentarily by means of two cells of dry battery, connected in series. If the lamp is properly lighted, a packing box which receives the batteries easily is selected, and two small brass hooks, *f g*, are straightened and screwed into the box near the top. Small copper wires are placed in electric contact with the hooks, *f g*, as shown in the diagram. At the top of the box is placed a switch, consisting of a piece of spring brass 3 inches long and ½ inch wide, held in place by a pivotal screw, *e*, passing through a central hole in the spring into the box. The wire from the brass hook, *f*, is placed in electrical contact with this screw, *e*, and two brass screws, *b c*, are inserted in the top of the box, to serve as contact points for the switch. These screws are connected together and with the zinc pole of the cell, *a'*, by a wire. The carbon pole of the cell is connected electrically with the hook, *g*. The hooks are curved downwardly and the terminals of the lamp, *n*, are wound three or four times around the ends of the hooks, *f g*, respectively, so as to support the lamp above and in front of the face of the watch, hanging upon the hook, projecting from the front of the box.

The longer arm of the switch is turned up to form a thumb piece, and is held normally out of contact with the screw, *b*. By pressing the end of the switch down into contact with the screw, *b*, an electrical contact is formed which lights the lamp. By turning the switch on its pivotal screw, *e*, it is brought into contact with the screw, *c*, thus forming an electrical contact, which is prolonged until the switch is returned to its original position. The movement of the switch is limited by the screws, *d d*.

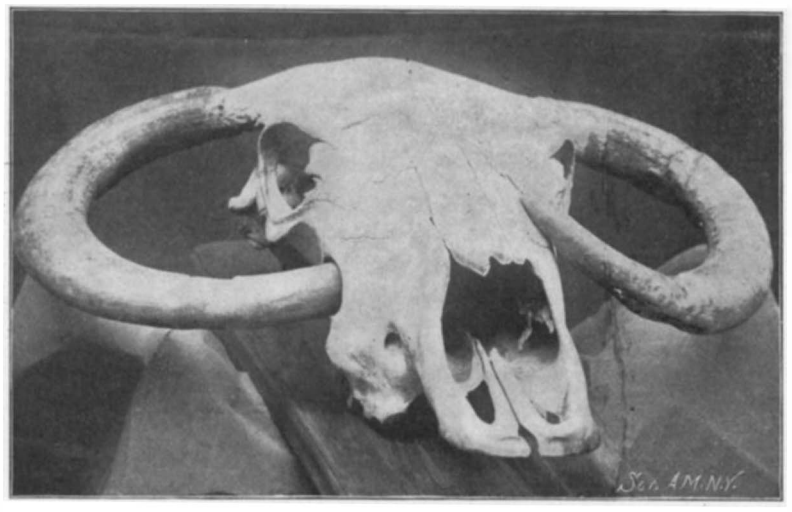
In one of the views the lamp is represented as being supported by a hollow wooden column in front of a clock. In this case one of the lamp wires is incased in a very small rubber tube, to insure insulation; otherwise the construction is similar to that described.

Two cells of dry battery will light the lamp occasionally, for a long time, if used only an instant each time; but if the lamp is used continuously, it runs the battery down, so that it will require frequent renewal.

Methods for Producing Low Temperatures.

At a recent meeting of the Academie des Sciences, M. d'Arsonval read a paper on the production of low temperatures, with special reference to methods of cooling which may be utilized in the laboratory or elsewhere, with the simple means at the operator's disposal. For instance, to descend to —60 deg. C., chloride of methyl is found convenient. It should be placed in a porous vase, such as that of a battery, to allow a spontaneous evaporation. To descend to —112 and even —115 deg., liquid carbonic acid or acetylene may be used. Both of these take the snowy state at the ordinary temperature. To dissolve this snow, acetone is the best, and is the solvent used by the author. Acetylene, as has been shown by Messrs. Claude and Hess, dissolves in large quantities in acetone. This solubility increases as the temperature is lowered, so that at —80 deg. C., for instance, the acetone will dissolve more than 2,500 times its volume of acetylene. The snow of carbonic acid acts in the same way, but is less soluble. By using the latter, dissolved in acetone, one can easily descend to —115 deg., provided the acetone has been previously cooled. This mixture constitutes a veritable freezing mixture, and the solution of the carbonic acid snow in the acetone (both having been previously cooled to the same point) takes place with an absorption of heat which lowers by 20 deg. the initial temperature of the mixture. The acetylene snow is as easily manipulated as the former and evaporates more slowly and at a lower temperature. This is due to its great latent heat of fusion (which is at least 55 calories per kilogramme) in passing from the solid to the liquid state. Acetylene, like carbonic acid, does not take the liquid state at atmospheric pressure, but it requires a supplementary pressure of about a third of an atmosphere. If acetylene snow is placed in a glass tube and the latter corked, the snow is seen to melt very slowly and the pressure is maintained in the interior of the tube equal to 24 centimeters of mercury throughout the duration of the fusion. M. Claude has utilized this property as a simple means of transporting acetylene.

To descend below —115 deg. C. it is necessary to use liquid air, and with this one has the advantage of obtaining very low temperatures and also of maintaining these constant. M. d'Arsonval then describes his method for proceeding with liquid air. In the first place, it is necessary to have a vessel as impermeable as possible to heat and to place it in a bath which remains unfrozen at the lowest temperatures. The author uses the silverized glass vessels with double walls which he first described in 1898 and which are now well known. As to the liquid bath, one of the most incongealable is the ordinary gasoline of commerce, and with very volatile samples one may descend to —160 deg. without freezing. They may, in fact, be used for thermometers, as Kohlrausch has shown, and M. Demichel has made a number of these lately. By successive rectifications it is possible to obtain gasolines which do not congeal even as low as —194 deg., which is the boiling point of liquid air at normal pressure. To cool the gasoline to the desired point it suffices to place at its upper part a small annular metallic vessel into which the liquid air is let fall drop by drop. For this purpose the author uses a silvered flask containing the liquid air, which is otherwise arranged like an ordinary washing-bottle, with one glass tube passing through the cork into the liquid and another short tube with a piece of rubber tubing at the exterior. When the rubber tube is compressed the evaporation of the liquid air creates a pressure which forces out a violent stream, but by opening the rubber tube more or less the flow can be regulated at will, and in consequence the temperature of the gasoline bath. The substance to be acted upon is placed, as above stated, in the double-walled vessel, and the latter in the gasoline bath, which is kept at the desired temperature by the dropping of the liquid air. M. d'Arsonval estimates that with a cylindrical silvered vessel of a liter capacity the loss may be reduced to 20 grammes of liquid air per hour, when working at —194 deg., which makes the use of liquid air quite practicable.



CURIOUS HORN GROWTH OF A NEW ZEALAND BUFFALO.

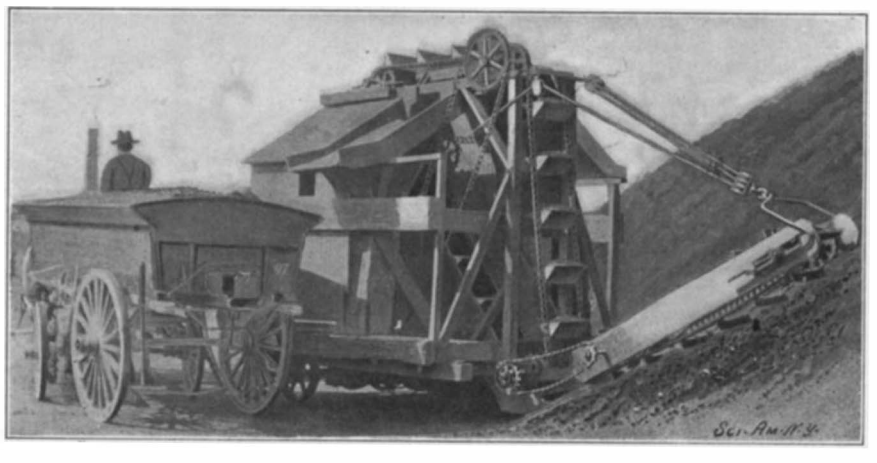
CURIOUS HORN GROWTH.

Our engraving represents a bullock's head with an ingrowing horn. The animal was originally one of a working team, the property of some Maoris (New Zealand natives), but escaped about twelve years ago and joined some wild cattle in the ranges. The left horn penetrates 4½ inches into the head through a hole 2¼ inches diameter. The other horn had also pierced the skin, causing an indentation in the skull. The animal was found by a party of surveyors in such a poor condition that it could hardly move, so it was shot. The head is in the possession of Mr. A. K. Blundell, Wavyanui, New Zealand, and the photograph was kindly sent to us by Mr. Johnson, of Danewirke, New Zealand.

PORTABLE COAL-LOADING MACHINE.

In a large retail coal yard in Philadelphia there is in daily operation a machine for loading the delivery wagons of the firm, the first apparatus of the kind which has ever been successfully operated. It is known as the Seitz loader, and is shown in active service in the accompanying illustration, made from a photograph. The machine is entirely self-contained, moving around the yard from pile to pile under its own power and loading the wagons entirely without any human assistance other than that which directs the running of the engine.

The loader is run to the vicinity of the coal pile, and an endless-belt raking device dropped thereon. The engine is started, and the coal is by this means brought to the elevator buckets, which dump it onto screens at the top of the machine, and after passing through these it is conveyed by spouts to the cart which stands at the side of the loader. The raking device and elevator are both operated by the same engine located in the interior. The machine shown in the cut has a capacity of one ton a minute, and takes the place of six laborers who were heretofore employed in shoveling and screening. This capacity can be increased, and with a trifling change the loader may be made to fill two wagons at one time. While it is primarily designed for coal, it can be used for lime, sand, gravel and other similar materials.



PORTABLE COAL-LOADING MACHINE.

The total amount that John D. Rockefeller has given to the University of Chicago is $10,251,000.

Engineering Notes.

The buildings of the Pan-American Exposition have been sold for $130,000 to a Chicago wrecking company.

The West Virginia University has recently received a gift of a passenger locomotive from the Baltimore & Ohio Railroad for experimental use in its new engineering building.

In one day 39,200 tons of iron were recently shipped from Ashtabula to the Pittsburg furnaces; fifty-five trains were handled in twenty-four hours, sixty-five locomotives being used; thirty-five locomotives and fifteen crews were borrowed from the main line for the occasion.

The Fire Department surgeons in New York city now attend second-alarm fires in order to attend to the injured firemen. On many occasions there has been a disgraceful conflict of authority between ambulance surgeons and firemen, in which the ambulance surgeons refused to carry out the orders of the firemen. Each Fire Department surgeon will take with him various dressings and articles for such emergencies. If the injured fireman requires to be treated in the hospital, he will be sent there in an ambulance.

Owing to the success which has attended the construction of the turbine passenger steamer "King Edward" upon the Clyde, another similar vessel is to be constructed. She is to be an improvement on the "King Edward" in every respect. She will exceed the dimensions of the latter vessel by 20 feet in length, 2 feet in breadth and 1 foot in draught. Her speed will be 22 knots—25 miles. She will be placed upon the Clyde for traffic between Campbelltown via Fairlie and Glasgow, and is to be completed in time for the pleasure traffic season of next year. Messrs. Denny Brothers, of Dumbarton, who built the "King Edward," will also construct the new turbine steamer.

Acetylene gas is now utilized for a variety of illuminating purposes in Sweden, owing to its low cost in comparison with other processes of lighting. Attempts are now being made to introduce it into factories, and it is anticipated that its employment will signify a very considerable saving. It has been calculated that a factory using fifty lamps of 16 candle power, each burning 720 hours per year, would find its lighting bill worked out as follows: With coal gas in common burners, $290; with electric incandescent lamps, $235; with petroleum, $150; with acetylene gas, $125. By this it will be recognized that acetylene is more than one-half as cheap as coal gas.

The British Naval Department contemplates introducing the German water-tube boiler into the English navy. Orders have recently been placed for experimental sets of the Duesseldorf-Ratingen water-tube types for trial in some of the cruisers, including the third-class cruiser "Medusa," used as a drillship at North Shields. Trials are also being made in other vessels of the "Medea" class, and it is to be fitted on the second-class cruiser "Encounter," a vessel of the improved "Highflyer" class, and at present equipped with Belleville economizers. The displacement of the latter by the German water-tube boiler will be watched with interest. The new boilers are said to give excellent results, but English naval engineers refrain from venturing an opinion regarding them until they have been submitted to severe trials.

The Parisian municipal authorities are paving several streets with glass. About twelve months ago the inventors of this process were accorded permission to lay down their glass pavement in certain thoroughfares on condition that, should the new material not be found to answer at the expiration of a specified time, the streets thus experimented upon were to be repaved in the old style at the inventors' expense. The paving has evidently given satisfaction, since the Municipal Council is laying down the glass in several of the busiest thoroughfares of the city. The vitreous paving-stones are made of powdered glass, which is baked until it becomes almost fluid, then compressed by hydraulic machines, and cut into cubes to facilitate the laying process. The chief objection against the glass pavement is that its surface offers no grip to horses' hoofs, which would render it dangerously slippery in wet weather, but results have proved that no greater danger is to be feared with this material than with the ordinary asphalt paving.

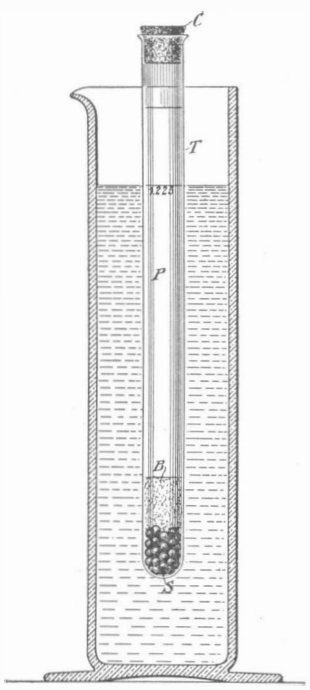
The work of constructing the great Simplon tunnel, which when finished will be 12½ miles long, and which will considerably facilitate railroad traveling in Italy, has been seriously interrupted by the striking of a copious vein of water which has flooded the whole of one section of the works. For several weeks boring to the south has had to be suspended. In the left gallery work is still going on, but all has to be done by hand, and the advance is little more than three feet a day. Here there is water also, but the pressure is less. However, when the streams of the two galleries unite, about 1,000,000 hogsheads of water will pass through every twenty-four hours. At first it was supposed that this enormous quantity of water came from Lake Avino, near which the tunnel passes, but such is not the case. Later investigations show that it probably emanates from the Cairasca torrent, which having its origin at the foot of Mont Leone, extends almost parallel with the tunnel. It is intended to prove this by the experiment of throwing a large quantity of strong coloring matter into the torrent, so that if it appears in the tunnel there will be proof that the water there comes from the Cairasca. In that case it will be necessary to open a new gallery to go round the inundation. Such an alternative will mean a great expense and occupy considerable time.

HOW TO MAKE A CHEAP HYDROMETER.

BY PARKER S. SIMONSEN.

There are many amateurs who have at one time or other tried to make a storage battery, but have given up in disgust on finding that their plates have sulphated, thus ruining their battery. This is often caused by not having the electrolyte of the proper density, but this fault can be corrected by the use of a hydrometer. Readings should be taken regularly with the hydrometer, and this will also form a valuable guide as to the amount of the charge in the battery; that is, the density of the electrolyte after charging will be found to be slightly greater than the limit of discharge. A simple and cheap hydrometer can be made as follows, which will more than repay the maker for his slight trouble:

Procure from a druggist or chemical house a test-tube (Fig. 1, *T*) 6 inches long and 7-16 of an inch in outside diameter. The test-tube should be free from flaws and very thin—about 1-32 of an inch in thickness. Now place some buckshot, *S*, in the bottom of the tube so as to form a column about a half-inch in height, or until it will float upright in water, the tube projecting about an inch above the surface of the water. A small wad of cotton, *B*, should be placed over the shot so as to hold them in place, and also a small strip of paper, *P*. should be placed inside of the tube on which to mark the necessary graduations. Now procure a bottle as long as the tube and large enough to allow the tube to pass into it. Fill this bottle full of dilute sulphuric acid having a specific gravity of 1.225 when cold. A druggist will put this up for a small sum, but if you wish to put this up yourself you can carefully add one ounce of good commercial sulphuric acid to four ounces of distilled water, and when this is cold place the tube in it. But before doing this place a small waxed cork in the mouth of the tube to prevent the liquid from accidentally flowing into it. Now mark the point to which the tube sinks into the dilute sulphuric acid, 1.225 specific gravity. If you desire any other graduations you can proceed as above, but you will then have to compare your hydrometer with a standard one. Most makers of storage batteries recommend the use of an electrolyte having a specific gravity of 1.225, so that is the only necessary mark. A small drop of glue on the strip of paper will hold it in place, completing your hydrometer.



HOME-MADE HYDROMETER.

Elastic Composition for the Preservation of Iron Ships Needed.

The life of iron and steel ships depends, other things being equal, greatly upon the prevention of corrosion in parts that are inaccessible and out of sight, such as the frames, reverse frames, shell plating directly above the cement in waterways, under the deck in the wake of stringer plates, and similar localities. The usual treatment of these parts to preserve them from rusting is to apply red-lead paint, but this is not a preventive, for the straining of the ship and wash of more or less bilge water soon cracks the thin coating so that the plates are attacked. An elastic coating that can be applied cold to the surfaces of iron and steel vessels would be of great value, but it should be comparatively cheap, contain no ingredients liable to spontaneous combustion in hot climates, and dry rapidly after application. These requirements are essential to the general adoption of such a cement or protective coating, and while they may be difficult to discover, will amply repay research in the direction indicated.

Electrical Notes.

A Michigan firm has just received an order to ship fifteen hundred telephone poles to the Telephone Company of Egypt, which is making extensive increases in its business and the area covered by its lines.

The capitol at Hartford, Conn., is being wired for electric lighting. Incandescent, arc and Nernst lamps are to be used. At the top of the interior of the dome a large Nernst lamp will be located, and under the railing at the top there will be a circle of thirty-six Nernst lamps.

According to a foreign contemporary, three electrical furnaces, of 500 horse power each, have been erected at Camonica, in the north of Italy, where the manufacture of pig iron by the Stassano patent will be engaged in. The ore and other material are ground together and formed into bricks, a composition of coal tar being the binder used. It is thus fed into the furnace and subjected to the current. The electrodes are at the bottom of the boshes.

The Society for the Study of Electric Railways of Germany has been carrying out a remarkable series of speed trials upon a new electric railway. The speed attained varied from 100 to 105 miles an hour. While running at the latter speed the pressure was found to be equal to a wind force of 12 feet per second, a force which has only been registered once on the German coast, in the hurricane of February, 1894. The engineers of the railway are confident that even a much greater speed can be attained.

A curious accident was caused recently by a cat climbing a pole of the Buffalo and Lockport Electric Railway. While attempting to walk along the feed wires her tail touched one of the 22,000-volt Niagara transmission lines. The cat was instantly killed, but a short circuit was caused by the body falling across the wires; this resulted in shutting off the power at Niagara for two hours. Several electric railways and lighting systems in western New York were without power. The next day another cat in Utica, N. Y., prowling around the power house in Utica, also caused a short circuit, which resulted in blowing out several fuses, and the cars were stalled for some time. The cat, however, was not injured and still lives.

The engineers of the Brooklyn Rapid Transit Company have drawn plans to reduce the congestion on the Brooklyn Elevated Road. A considerable section of the Myrtle Avenue division is very much overcrowded, owing to the fact that the Long Island, Fifth Avenue, Bay Ridge, Borough Park and other trains which reach the suburban districts have had to cross Fulton Street and use the Myrtle Avenue and Adams Street line as the only means of reaching the bridge, while the traffic on the Fulton Street line is not very heavy. The plan proposed is to connect the Fulton Street and Fifth Avenue lines at Flatbush Avenue. The difference in the grade of the two roads will be adjusted by an incline. The closing of a number of stations on the Fulton Street line is also contemplated, with a view to reducing the number of stops and making the service to the bridge of an express nature for long-distance travelers. Naturally this has aroused considerable antagonism.

Some interesting experiments for the artificial production of rain by means of electricity have been carried out in Japan. The probability of greater success being obtained by this means, in lieu of the system of detonating explosives in the upper air strata, has often been advocated by scientists. This attempt by the Japanese, however, is the first practical effort to prove the truth of this theory, and it was attended with conspicuous success. The trials were made in the Fukushima prefecture. Operations were commenced at eleven in the evening, but there was no sign of atmospheric change until nine o'clock next morning, when a cluster of clouds was observed over the hill on which the experiment was held. At length rain began to fall, followed by a second fall at eleven A. M., and afterward a third, fourth, and fifth—the last being about 9:30 in the evening. The area upon which the rain fell extended over many miles. As a single experiment of this description is scarcely conclusive, the scientists who carried out these particular trials propose to repeat them, with a view to establishing the feasibility of the idea. It will be recollected that we recently published in the SCIENTIFIC AMERICAN an article describing the influence of electricity in connection with the weather.

The Current Supplement.

The current SUPPLEMENT, No. 1363, contains many articles of unusual interest. "Animal Haunts and Trapdoors" is an admirably illustrated article on natural history. "Recent Science" is a paper by Prince Kropotkin. "Scenes from Kilima Njaro" is an attractive article on exploration, and is accompanied by a number of engravings. "The Dignity of Chemistry" is by Dr. H. W. Wiley, Chief Chemist of the United States Department of Agriculture.

THE NEW YORK ASSAY OFFICE.

As is well known, the United States is one of the most important gold-producing countries in the world. The amount of gold produced in the calendar year 1899 was 3,437,210 ounces fine, of the value of $71,053,400, this being exceeded only by Australasia, which furnished $79,321,581, and Africa which produced $73,227,108. The total production of the various colonies and countries in these continents, including the United States, was 10,820,000 ounces fine, having a value of $223,600,000, making 73 per cent of the product of the world. The output of the United States in 1899 is the largest in its history, exceeding by $6,053,400 the estimated product for 1853, the record year following the discovery of California placers. The gold, however it may be obtained, is put upon the market by private refineries, by the Mint and Assay offices. During the calendar year, 1899, the domestic product in fine bars reported by private refineries amounted to 2,434,248 fine ounces, while unrefined gold of domestic production, deposited at the Mint and Assay Office amounted to 999,504 fine ounces.

The production of silver during 1899 was also a considerable amount, amounting in value to $32,858,700. The Mexican product amounted to $33,367,300. Geographically the world's output of silver in 1899 is distributed as follows: North, Central and South America, $83,400,000; Europe, $8,300,000; Australasia, $7,600,000; Asia (Japan) $1,000,000, making a total of $100,300,000. The value of the gold coinage for the fiscal year 1899-1900 was $107,937,110. The value of silver dollars was $18,244,984. The coinage of subsidiary silver pieces amounted 57,114,270 pieces of the value of $12,876,849.15 and of mining coins to the extraordinary total of 101,301,753 pieces of the value of only $12,243,017.21. We have already outlined, in the SCIENTIFIC AMERICAN for September, 7, 1901, the operations carried on at one of our mints, and we now take up another phase of the subject which is as interesting, the Assay Offices, the one which we select being located at New York. The importance of the Assay Office in its relation to the financial world, the Treasury and the Mint cannot be over-estimated, and the process of melting and refining of bullion will form the subject of a subsequent article.

During the fiscal year ending June 30, 1900, the fineness of 11,802 melts of gold and silver deposits, 993 melts of fine gold and silver, also 1,050 melts of mixed metal, about 500 special deposits, 350 barrels of sweeps, 83,178 gold and silver bars were estimated, and about 60,000 cupels and the necessary "proof" gold and silver were made.

The Assay Office in New York was established by law in 1853, and was opened in the autumn of 1854. The first Assayer of the New York Assay Office was Dr. John Torrey, of Columbia College, who was appointed in 1854 and held his position until 1873. On his death he was succeeded by his son, Mr. Herbert Gray Torrey, who has been in office for forty years. The Superintendent of the Assay Office is Andrew Mason, who was appointed to his present position in 1883, having previously been Assistant-Assayer and Melter and Refiner. While holding the latter office he substituted the use of sulphuric for nitric acid in the refining process, which will be described in a subsequent article, thus saving this one Assay Office $100,000 per annum.

The United States Assay Office is located in a low modest-looking marble building located beside the more imposing Sub-Treasury building at the intersection of Wall and Broad Streets, which marks one of the most historic spots in the country, namely, the site of the old Federal Hall where Washington took the oath as first President of the United States. Although the building is small, yet it only masks a really large, inner building surrounded on all sides by office buildings and the Sub-Treasury. The Assay Offices, and particularly this one, have an important position in the world of finance, for here the precious metals —gold and silver—in all forms and conditions of fineness are assayed and refined. In brief, the work of this office consists in assaying or determining the value of gold and silver, in whatever form presented, as coin, jewelry, or in any other shape. Any one wishing to have gold or silver assayed in quantity or wishing to sell to the government, may present his property at the Assay Office, where he may have the metal reduced and made into bars, or if he prefers, he may sell his bullion direct to the government.

The charge for doing the work is merely nominal, and is based on the actual cost. Millions of dollars are stored at all times in the vaults, and at the time our photographs were taken, the amount of gold and silver was about $40,000,000. When the precious metal is received, the first step consists in weighing the coin, bars, jewelry or tableware. This is done with great exactness and a receipt is given. Each person's holdings are placed in a box and are taken to the melting room, where they are placed in crucibles with a flux and smelted and cast in ingot molds, the pouring being a highly picturesque operation. A small chip is taken from the bar for assay.

The chip is taken to the Assay room, where a hydraulic press reduces the sample to a size which permits of it being run through drawing rollers, so that the sample may be cut from the ribbon with the weight of one gramme. This is placed in a small unglazed earthen cup termed a "cupel," and a known quantity of silver, copper and lead is added before firing, for the following reasons: The function of the lead, which is in the form of a thin sheet, is two-fold; first, it serves as an envelope to hold the particles of bullion, silver and copper together, while melting, and the lead also oxidizes freely, dissolving the copper oxide and making it possible for both oxides to be absorbed by the porous body of the cupel. Silver is added so that the proportion of silver in the sample of bullion shall be approximately two of silver to one of gold, and that in the subsequent acid bath the gold shall not surround or mask the silver so as to prevent it from dissolving. In cooling the "button" which remains in the cupel after firing is apt to spurt up, thus wasting a portion of its weight and destroying the value of the assay. The lead oxide assists the copper oxide to be absorbed by the cupel. The cupel and its contents are now placed in a muffle furnace, and heated for a period sufficient to insure complete melting. If there be any copper or lead present in the sample, they will become alloyed with the copper and lead added by the Assayer, and will become oxidized and absorbed. The gold and silver, together with the known quantity of silver which has been added by the Assay Office, remain in the cupel in the form of a "button." Each button is placed in a special tray which keeps each sample by itself and is then flattened and rolled, boiled in nitric acid, 32 deg. Baume, for ten minutes, and then in fresh acid for ten minutes more. The silver is dissolved by the acid, forming silver nitrate, while the gold remains intact because only nitro-hydrochloric acid, so-called "aqua regia," dissolves it. Gold is left in the flask and is washed and weighed. The loss of weight in the furnace is base metal—lead and copper. The loss of weight in the nitric acid is silver, and the remainder is gold. In the case of silver bullion it is subjected to the humid test as well.

So far the government has been acting as an Assayer, but if the depositor wishes to part with his bullion, which is now of known value, the government pays for it at the prevailing price and proceeds to separate or part the gold from the silver. This operation will be described in a subsequent article. The price of gold never varies, costing $20.67 a fine ounce. Silver fluctuates with the market.

Electrolytic Apparatus for Hydrogen and Oxygen.

The Schuckert Company, of Germany, has lately brought out an electrolytic apparatus for producing hydrogen and oxygen on an industrial scale, and it is claimed that the gases can thus be produced very easily and economically. The apparatus has the form of a series of tanks or reservoirs, above which are the bell-shaped receptacles for the gases. Both tanks and receptacles are constructed of cast iron, and only the electric conductors are of copper. A solution of 15 per cent caustic soda in water is used for the electrolyte and the voltage is from 2.8 to 3 volts for each apparatus. A number of the latter are generally used, and are connected in series. The solution is kept heated to a temperature of 70 deg. C. during the action and an electric heating device is used in the present case, although if steam heat is available the heating is of course much more economical. Each of the gases, given off at its electrode, is accumulated in the bell-shaped receiver, and where a number of apparatus are used the receptacles for each gas are all connected by a common tube. The gases are passed into a washing chamber, which retains all traces of soda which may be brought over. With proper precautions it is possible to obtain oxygen and hydrogen of 97 or 98 per cent purity. A great advantage of the electric apparatus is that the production of gas may be instantly controlled to any desired point and stopped at will. Each element contains about 10 gallons of soda solution and takes a current of 600 amperes. It weighs about 500 pounds. A tank of this capacity will produce per hour 55 gallons of hydrogen and 28 of oxygen at the ordinary temperature and pressure. An outfit for producing 100 cubic yards of oxygen and 200 of hydrogen per 24 hours contains 40 of these elements and is estimated to cost $4,500. When the current is furnished by a hydraulic plant, the figures show that the gas can be produced as low as 25 cents per cubic yard, or 50 cents if it is to be compressed in tubes for shipment.

A project is on foot to make gas near coal mines and pump it 124 miles to Paris. It would be sent highly compressed, and the pressure would be reduced for consumption. It is expected if this project is carried out that gas can be supplied for 28.7 cents per 1,000 cubic feet to the city, 57½ cents for private lighting and 34½ cents for use as fuel.

Automobile News.

Now that road races are forbidden in France, automobilists have taken to hill climbing and mile and kilometer events.

Automobiles across the Caucasus for carrying the Russian mail are to supplant the present transport post-horses, with changes every ten miles.

Automobile cabs are again demonstrating their usefulness in New York and other cities during the inclement weather when horses are so often helpless.

The Automobile Club of Great Britain proposes to establish a motor-car school for the teaching of motor-car driving, at which members and their servants can learn driving and the management of motor vehicles, and from which thoroughly respectable and competent servants will be obtained. In England at the present time there are very few automobilists who possess more than the most elementary knowledge of motor-car driving or the management of a vehicle.

The Automobile Club of London some time ago offered a prize of $600 for a device to overcome the dust nuisance caused by pneumatic tires. The judges were Prof. Vernon Boys, F.R.S., and Mr. Worby Beaumont. The suggestions for remedying this grievance, however, have been so disappointing, and the schemes submitted so impracticable, that the judges have declined to make an award. However, the club have extended the period of the competition until the beginning of June, by which time it is to be hoped some palliative of this great drawback will have been discovered.

The idea of constructing a special road for motor cars from London to the South Coast of England has been mooted. Mr. George Lowithain, a well-known civil engineer and enthusiastic motorist, is interested deeply in the scheme. He suggests the construction of a track 80 feet wide, paved with 4 inch granite cubes laid on pitching with a covering of concrete sufficient to prevent settlement of the paving sets into holes or ruts. Such a road would approximately cost $260,000 per mile. The cost of a macadamized road laid on stone pitching and well grouted and rolled with a steam roller would be about $135,000 per mile.

One of the greatest difficulties encountered by automobile drivers is in connection with the water circulation. Pump troubles are so frequent that one or two English manufacturers have endeavored to surmount the obstacle by a system of air cooling. But the idea is generally condemned. Yet in a recent run from London to Southsea, a distance of approximately 70 miles, three 10 horse power cars equipped with the air-cooling apparatus covered the journey without the slightest hitch, and when they arrived at their destination were in perfect condition. At no part of the journey were any signs of those troubles generally conceded to be characteristic of the air-cooled motors observed, and, in fact, these particular automobiles conclusively proved that the system could be utilized in lieu of the pumps. In view of their conspicuous success on this occasion these three cars are to be submitted to further exacting trials to substantiate the advantages of the air-cooling system.

Some important brake trials have been made by the Automobile Club of Great Britain on a private road in the grounds of Welbeck Abbey for the purpose of obtaining conclusive data of the space within which motor vehicles can be stopped when driven at high speeds. The road had a steady gradient throughout the measured mile run, selected for the tests, of about 1 in 60. The cars were timed over the full mile, and also over the last one-twentieth of the mile (88 yards), in order that the speed at which the cars were traveling at the end of the mile might be ascertained. As the front wheels of the cars passed over the tape at the end of the mile their brakes were applied, and when they came to rest the distance from the tape of the point at which the front wheels rested when the car stopped was carefully measured. The stopping of the cars on the flat, on a hard, dry road, showed that at the undermentioned speed the cars could be stopped on an average in the following number of lengths; a length for this purpose was calculated to be 11 feet 8 inches, as that was the average length of the cars engaged in the trial.

Miles per hour.

1. 11 to 14, 1 4-5ths times the car's length.
2. 15 to 17, 2 times the car's length.
3. 18 to 20, 2¾ times the car's length.
4. 20 to 24, 3½ times the car's length.

The figures given above are averages. As a matter of fact, one car traveling at 13 miles per hour was stopped in 4 yards; another traveling at 18½ miles per hour was stopped in 7 yards; and a third when going at 20 miles per hour was stopped in 12 2-3 yards. The average weight of the vehicles without passengers was 24 hundredweight. From these results it will be seen that motor-cars can, on an average, be stopped, when traveling at 20 miles an hour, in less distance than the ordinary horse vehicle can be pulled up when traveling at 10 miles an hour.

THE IMPROVEMENT OF WASHINGTON.

BY OUR WASHINGTON CORRESPONDENT.

After months of study and investigation on the part of architects and sculptors of the highest professional standing, there has lately been formulated a most pretentious plan for what might virtually be termed a new Washington, so elaborate is the scheme for remodeling and reconstructing the capital city along the lines planned when the city on the Potomac was originally laid out—a project which, as at present contemplated, constitutes the most magnificent advance in civic government ever undertaken in the United States. To define briefly the scope of the improvements outlined, it may be said that the object of the enterprise is to bring into harmonious relation with one another the Washington Monument, the proposed Memorial to Abraham Lincoln, the White House and all public buildings including the Capitol; in short, to make the American seat of government still more beautiful by treating artistically and scientifically the entire territory of the District of Columbia.

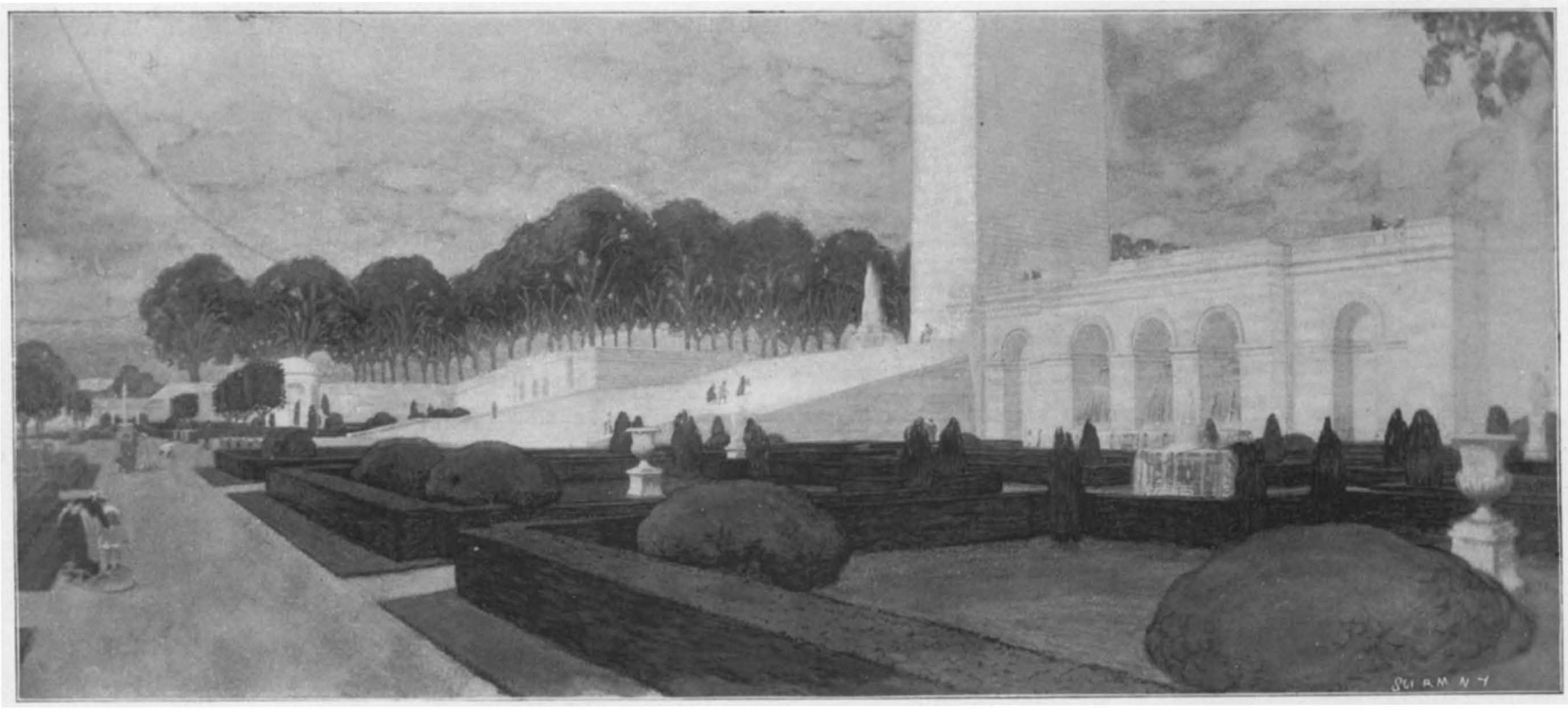
The city of Washington differs from all other American cities in the fact that in its original plan parks were laid out as settings for public buildings. Even the broad avenues of the capital were arranged so as to enhance the effect of the great edifices of the nation, and the squares at the intersection of the wide thoroughfares were planned as sites for memorials. Parks in the modern sense of large public recreation grounds were unprovided for, but instead there were embodied numerous small areas designed to beautify the connections between the various departments of the government.

During the nineteenth century, however, Congress, seeing no prospect that the government buildings would ever require so large and grand a setting, diverted from the original purpose. The great space known as the Mall, which was intended to form a unified connection between the Capitol and the White House and to furnish sites for a certain class of public buildings, was cut into fragments, each portion receiving a separate and individual informal treatment, thus substituting diversity for harmony; many reservations passed from public into private ownership, with the result that public buildings have lost their appropriate surroundings, and new structures have been built without that landscape setting which the founders of the city relied upon to give them beauty and dignity.

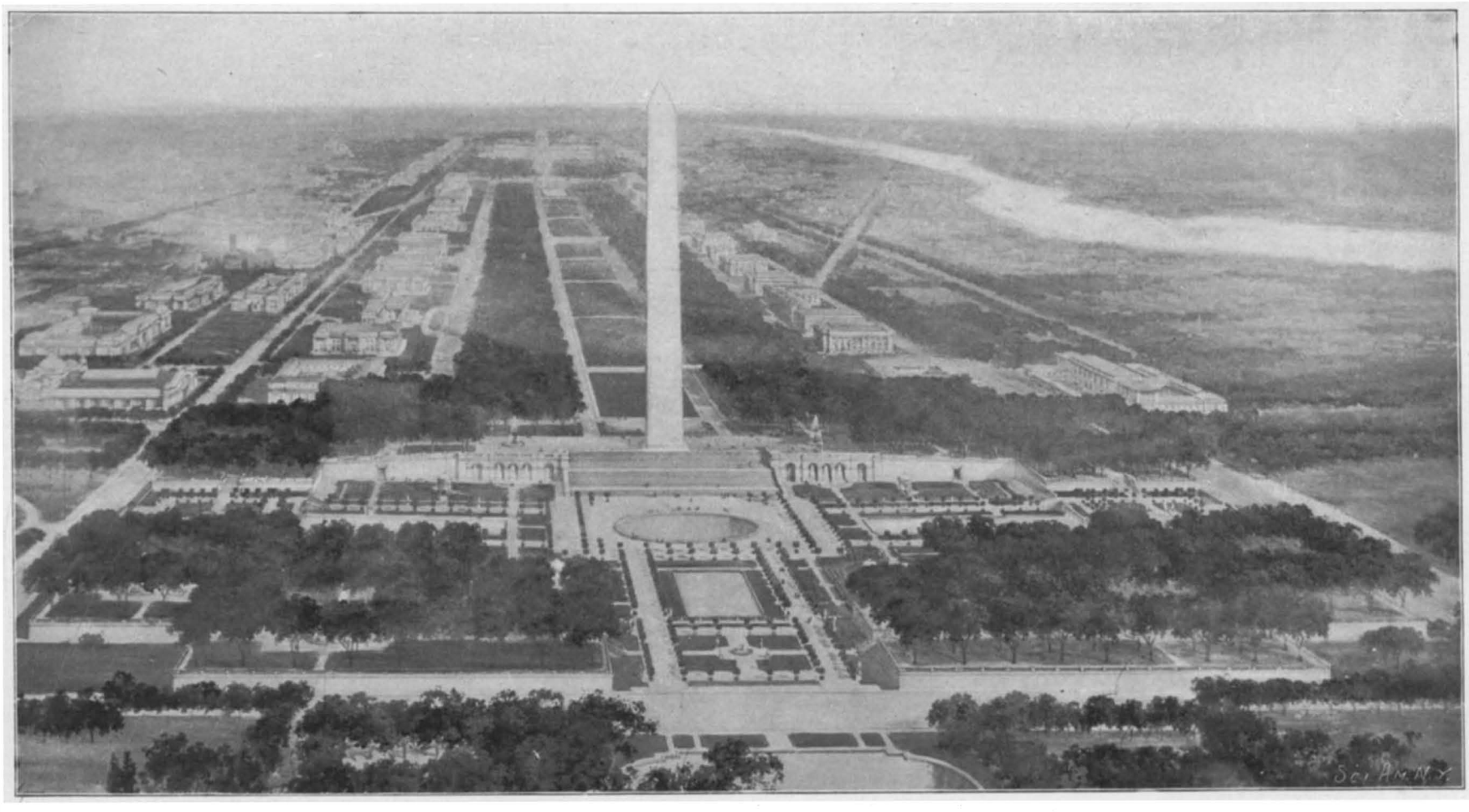
Of late years the demand for new public buildings and memorials has reached an acute stage; and impelled by the embarrassment in locating these because of the difficulty in securing appropriate sites, the United States Senate in the spring of 1901 ordered the preparation and submission of a general plan for the improvement of the District of Columbia. The Senate committee having the matter in charge met the representatives of the Institute of American Architects, and agreed to the proposition of the latter that Mr. Daniel H. Burnham, of Chicago, and Mr. Frederick Law Olmsted, Jr., of Brookline, Mass., be employed as experts with power to add to their number. These gentlemen subsequently invited Mr. Charles F. McKim and Mr. Augustus St. Gaudens, of New York, to act with them in the preparation of plans.

The work of this special commission has been to devise a plan which will tend to restore that unity of design which was the fundamental conception of those who first laid out the city as a national capital, and to formulate definite principles for the placing of those future structures which in order to become effective demand both a landscape setting and a visible orderly relation one to another for their mutual support and enhancement. The chief aim of the commission in all branches of the gigantic project, however, has been to carry to a legitimate conclusion the comprehensive, intelligent, yet simple and straightforward scheme devised by L'Enfant under the direction of George Washington and Thomas Jefferson.

The proposed improvement of the Mall is very extensive. It is proposed to secure for it a uniform width of 1,600 feet throughout its entire extent. The axis of the Capitol and the Washington Monument is to be clearly defined by an avenue a mile and a half in length and 300 feet broad, walled on either side by elms planted in formal processions, four abreast. The cross axis of the Mall, forming a thoroughfare between the body of the city and the river front, will be laid



Garden and Terrace at the Washington Monument.



View Toward the Capitol, Showing Boulevard and New Department Buildings.

THE PROPOSED EMBELLISHMENT OF THE NATIONAL CAPITAL.

out as a garden. Areas adjacent to the Mall and averaging more than 400 feet in width from the Capitol to the Washington Monument are set aside as sites for the great museums and buildings devoted to scientific purposes. Perhaps the feature of this portion of the plans which serves as the greatest cause for congratulation is found in the arrangement whereby the unsightly railway terminal which is now set down in the Mall will be removed to another portion of the city.

Not only will the monument be brought into the Capitol vista, but the Mall will be restored to its original use as a grand setting for the two great buildings of the nation, the Capitol and White House. To the distance of one and a half miles from the Capitol to the monument the reclamation of the Potomac flats adds another mile, giving opportunity for an extension of the treatment accorded the Mall and also a new and great memorial to Abraham Lincoln, to stand on the axis of the Capitol and monument, near the bank of the Potomac. The proposed Lincoln Memorial consists of a portico of Doric columns 250 feet in length by 220 feet broad. The Lincoln Memorial will be the gate of approach to the park system of the District of Columbia. A broad paved quay or landing space will skirt the Potomac; the proposed Memorial Bridge, to be erected at a cost of $15,000,000, will lead directly across the Potomac to the mansion house at Arlington, the national cemetery; and drives up the valley of Rock Creek will afford natural connection to the National Zoological Park.

Connecting the Washington Monument and the Lincoln Memorial will be a canal 200 feet in width and 2,300 feet in length and similar to those at Versailles and Fontainebleau. West of the monument it is planned to place a garden, which will not only add to the impressiveness of the structure, but create an axial relation with the White House, this latter being accomplished by a sunken garden framed in by tree-bearing terraces in the shape of a Greek cross. The center is marked by a great pool, and rectangular basins support this. From the garden a flight of steps 300 feet in width lead to the base of the monument, giving that structure forty additional feet of height. The space south or in the rear of the White House will be left practically undisturbed. Between the monument and the Potomac will be a great place of recreation to be known as Washington Common, and the plan for which contemplates a great stadium bordered by smaller playgrounds.

The south side of Pennsylvania Avenue, now a blot upon the city, is designated as a site for the District Building (which corresponds to a City Hall), the Armory for the District Militia, a Hall of Records and other similar structures. The connection between the Mall system and the Capitol is formed by a rectangle 1,000 feet long and 450 feet wide, relieved by plots of green and flanked by two public buildings which will stand as sentinels to the Capitol. The chief decoration of this area, to be known as "Union Square," will be the Grant Memorial, associated with which will be the figures of his great lieutenants, Sherman and Sheridan, standing independently yet forming a single composition. The grounds at the Capitol will be elaborated by terraces relieved and enriched by basins and fountains, in which the water falling from one level to another is poured finally into a great central basin at the street level. Indeed, the Commission, impelled by the fact that Washington experiences during four months of the year extended periods of intense heat, has provided for a wonderful array of fountains and for an increase in the water supply which will make possible the copious and even lavish use of water in these fountains. In addition to these main features, the plan for the improvement of Washington embraces many minor projects, such as the creation of a magnificent "Cliff Drive" on the Palisades of the Potomac, and the creation of a great boulevard system connecting the various parks.

The most recent application of the electric current is that of taking the place of the old-time bed warmer. The modern implement consists of a coil of wire covered with asbestos, and the electric current passing through the wires heats up the material.

THE YERKES OBSERVATORY TWO-FOOT REFLECTOR.

BY MARY PROCTOR.

Among the many important pieces of work which have been accomplished in the instrument shop of the Yerkes Observatory, has been the mounting of the two-foot reflecting telescope, with which the faint nebula surrounding Nova Persei (referred to in the SCIENTIFIC AMERICAN for December 7, 1901) was photographed.

The telescope is mounted in the southeast dome of the observatory, which was originally intended for a 16-inch refractor. A substantial observing platform or floor, 20 feet in diameter and 12 feet higher than the original floor of the tower, was also built, so that the eyepiece or plate-holder of the telescope is never more than 11 feet above the floor, and is therefore easily accessible with the aid of a suitable observing chair.

While the instrument is generally called the two-foot reflector, the clear aperture of the large mirror is 23½ inches, the focal length being 93 inches. The disk of glass for this mirror was made at the St. Gobain glass works near Paris, for Prof. G. W. Ritchey, who finished the work of grinding, polishing, and figuring it in 1896, at his own laboratory in Chicago.

In the case of a reflecting telescope of large angular aperture, such as the present instrument, great rigidity of the tube and extreme stability of support of the optical parts are absolutely essential, in order that the optical parts shall remain in perfect adjustment. And no less important are the perfection of the driving mechanism (by which the telescope is made to follow the apparent motion of the heavenly bodies from east to west across the sky) and of the guiding mechanism, by which the observer corrects any minute irregularities of movement. The parts of the mounting concerned in the four important requirements just mentioned were designed with great care by Prof. Ritchey and constructed under his supervision. The arrangement of the polar and declination axes is similar to that used in the German type of equatorial mounting; but the end of the tube below the declination axis is so short that it will pass the column without obstruction for all declinations, so that reversal of the instrument when passing the meridian is unnecessary. Long-exposure photographs can therefore be started four or five hours east of the meridian, and continued for eight or ten hours when required.

The driving clock, part of which can be seen inside the column in the illustration, is similar in general plan to that of the 40-inch refractor, and is one-fourth the size of the latter, the governor making two revolutions per second instead of one, as in the larger instrument. The governor balls weigh about seven pounds each, and all parts of the clock are proportionately heavy and strong. The winding drum is provided with a maintaining device, the winding at present being done by hand and requiring attention every two hours.

The driving worm and worm-gear, which directly rotate the polar axis, were ground together for 200 hours with fine grades of emery (such as are used in optical work) and oil, and the smoothing was finished with optical rouge and oil. To this grinding the extraordinary smoothness of driving of the instrument is largely due.

The plan of support adopted for the large mirror is as follows: "The mirror rests upon three very rigid cast-iron plates, 10 inches in diameter, the upper surfaces of which are ground to fit the back of the mirror. One thickness of writing paper is placed between each iron plate and the glass. Each plate is supported at its center on a strong ball-and-socket joint. The three balls form the upper ends of the three large adjusting screws which extend through the heavy back casting, and by which the mirror is adjusted for collimation. The edge support adopted consists of four strong steel bands, each of which is in contact with nearly one-half the circumference of the mirror; two opposite bands are just above the middle of the edge of the mirror; the other two, 90 deg. from the first, are just below this plane. In addition, four long rigid arcs of cast-iron are used to give greater stability of position laterally; two of these are bolted down to the large casting behind the mirror; the other two are held against the edge of the mirror by weak springs."

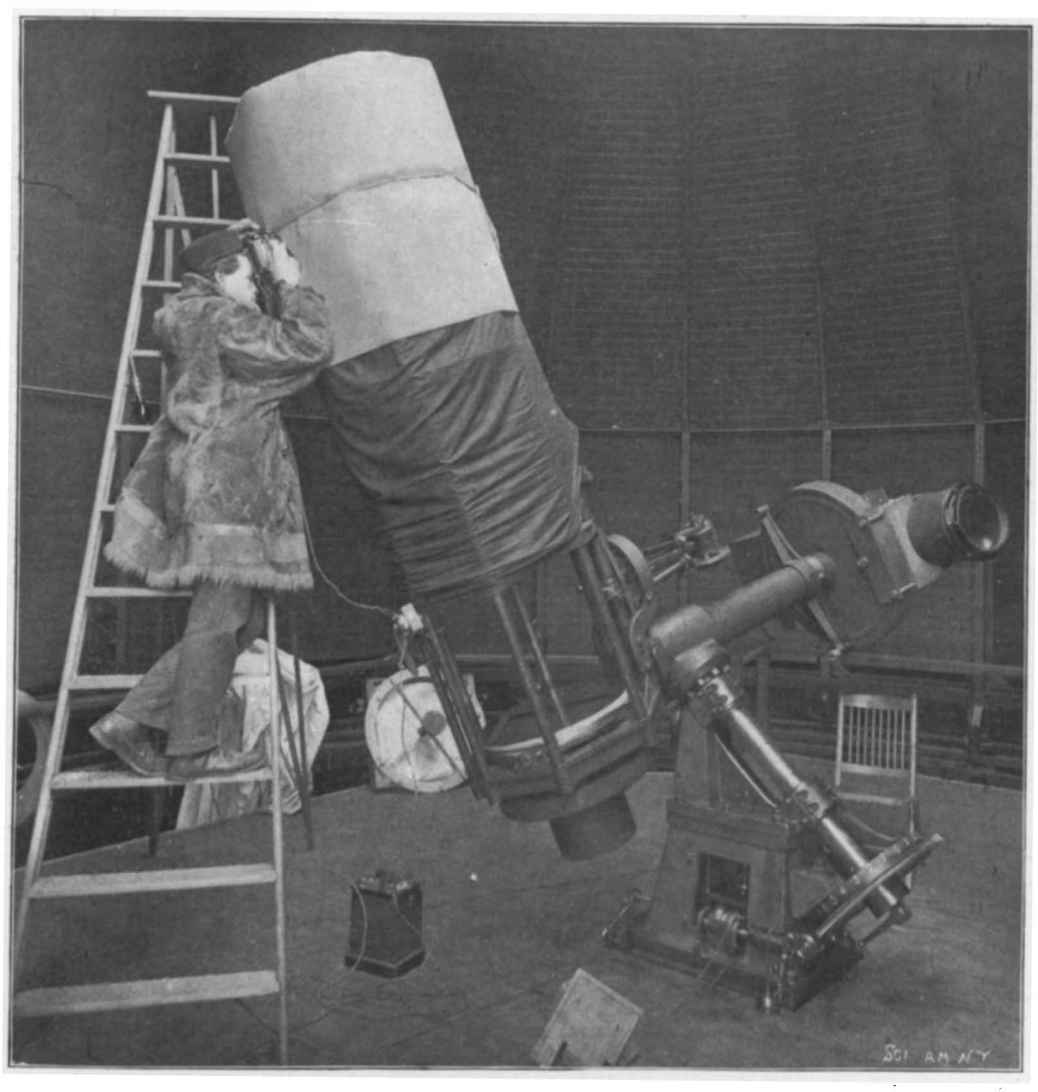
The skeleton tube is about seven feet long, and is constructed of eight two-inch steel tubes, which are connected by three strong light rings of cast aluminium. The rings are driven on the tubes, and each junction is tightly clamped with two strong screws. When the telescope is used with the double-slide plate-holder for direct photography at the first focus, an attachment is used consisting of a strong cast-aluminium ring which carries, by means of four thin wide bands of steel, the diagonal plane mirror and its supports.

The double-slide plate carrier used with the two-foot reflector is the same which was used in Prof. Ritchey's first experiments in photographing with the 40-inch telescope with a color screen. In the latter work a large sliding plate-carrier taking 8 x 10 inch plates is now used. The smaller one takes 3¼ x 4¼ inch plates, and the field photographed is three inches square, which corresponds, in the two-foot reflector, to a portion of the sky about two degrees square.

In regard to the exposures, the telescope is of course always moved by the driving mechanism (the clockwork in the column) during an exposure, but in addition to this the observer watches and "guides" throughout the entire exposure. This is not done in the old-fashioned and clumsy way of moving the entire telescope to make the necessary corrections (by means of "hand slow motions") but by means of what is called the double-slide plate carrier, in which the photographic plate, in its plate-holder, is carried on two very finely made slides, at right angles to each other, which can be moved by two screws held in the observer's fingers. By this means the necessary small corrections can be made with extreme delicacy and quickness.

At the edge of the field a "guiding star" is selected and is brought to the intersection of the spider lines in the "guiding eyepiece," which is carried on the same frame which also carries the photographic plate, so that the two move together. If the observer keeps the "guiding star" exactly bisected on the spider lines, he also keeps all of the stars of the field being photographed immovable on the photographic plate, despite any small errors which may occur in the clock driving.

This guiding is done throughout all exposures, long or short, which accounts for the excellent results obtained. In Prof. Ritchey's best photographic work with the reflector, double stars only 2½ seconds of arc apart are sharply separated. In the illustration showing the two-foot reflector, with which the Nova Persei nebula photographs were taken, Mr. F. G. Pease, Prof. Ritchey's assistant, is represented at the sliding plate carrier, with his fingers on the screws and his eye at the guiding eyepiece. The clockwork is seen in the column, and the two-foot silvered glass speculum is



TWO-FOOT REFLECTOR WITH WHICH PROF. RITCHEY PHOTOGRAPHED THE NEBULA SURROUNDING NOVA PERSEI. HIS ASSISTANT, MR. PEASE, WORKING THE DOUBLE-SLIDE PLATE-HOLDER.

seen at the lower end of the skeleton framework or tube.

The combination of stability of position of mirror, smoothness of clock driving, rigidity of skeleton tube, and delicacy of following made possible by the use of the sliding plate carrier, is so effective that when atmospheric conditions are good the image of the guiding star in the eyepiece of the plate-carrier does not wander by so much as one one-hundredth part of a millimeter during an exposure of three or four hours. The accuracy with which the star images are kept immovable on the photographic plate is nearly as great, as is shown by the photographs.

The results obtained with the two-foot reflector show that very fine atmospheric conditions are necessary for the best results, even in the photography of nebulae. What then would be the results if a properly mounted great reflector were erected in such a climate as that of California.

Prof. Ritchey has given a detailed account of the construction of the two-foot reflector in the Astrophysical Journal for November, 1901, of which the above sketch is a synopsis.

The Changing Use of Gas.

BY ALTON D. ADAMS.

Since the introduction of electric lighting, early in the decade 1880-1890, gas has grown less important as an illuminant and its application to heating has greatly increased. This movement in the use of gas is away from a field where it is less efficient than electricity, to one where its heating qualities can be used to greater advantage. An ordinary gas burner consumes about five cubic feet of gas per hour and yields a light of approximately 16 candle power. Each cubic foot of this gas burnt develops about 650 heat units, or 3,250 units per hour at the burner of 16 candle power. Incandescent electric lamps of 16 candle power regularly consume energy at the rate of 50 watts each. One watt-hour is the equivalent of 3.412 heat units, so that the incandescent lamp of 16 candle power develops 170.6 heat units hourly. It follows that the energy required to maintain the open gas flame for a given illumination is nineteen times as great as that necessary in incandescent lamps for equal service.

If the electrical energy required by the incandescent lamp be supplied to a heater, the amount of heat there produced is exactly the same as the amount that would have been developed in the lamp. If the gas required for a given illumination at an open flame be burned in a gas stove, the development of heat there is fully as great as it would be at the burner. Where the gas is perfectly burned and the products are cooled before they escape the electric heater and the gas stove are equally efficient. In many cases, however, the combustion of the gas is not complete, and even where it is completed the heat is not usually extracted from these products before they escape. In the transformation of electrical energy to heat the efficiency is necessarily exactly 100 per cent, and there are no products of combustion to carry away part of the heat. For the reasons just stated the efficiency of the gas stove may easily drop 75 or even 50 per cent. If the gas stove extracts from the gas passing through it only one-half of the possible amount of heat, the gas is still 9.5 times as effective as a heating as it is as a lighting agent, taking the results attained with electrical energy as unity in each case.

The general tendency is to shift the use of gas to that field where it is under the least disadvantage. This tendency is well illustrated by changes in the number of gas street lamps and of gas stoves used in Massachusetts during the past fourteen years. In the accompanying table the number of gas street lamps and of gas stoves operated in each year from 1887 to 1900 are stated as deduced from the reports of the Gas and Electric Light Commissioners of Massachusetts.

GAS STREET LAMPS AND STOVES IN USE IN MASSACHUSETTS.

Year Ending June 30.	Street Lamps.	Gas Stoves.	Gas Stoves in Boston.
1887	18,990	2,378	
1888	18,335	4,003	
1889	17,260	6,328	
1890	15,493	7,418	
1891	14,107	8,666	
1892	13,324	10,795	
1893	12,971	12,880	
1894	12,700	15,877	
1895	11,701	42,563	23,881
1896	11,693	72,195	49,610
1897	11,988	78,667	53,350
1898	12,407	79,335	47,698
1899	12,876	87,201	47,635
1900	13,308	95,547	48,064

For the fiscal year of 1887 the number of gas street lamps throughout the State was 18,990, but for 1900, thirteen years later, the number of these lamps was only 13,308, a decline of 30 per cent. This decrease in the number of gas street lamps took place in spite of a rapid rise of population during the period under consideration. Figures are not at hand to show the rate of increase for the population of the State since 1887, but from 1890 to 1900 this increase was 25.2 per cent. If the use of gas street lamps had only kept pace with the rise in population, the number of these lamps in 1900 would have been more than 25,000 instead of 13,308. While it is not possible to give the numbers of gas street lamps in years prior to 1887, it seems certain that there was a constant decline during nearly all of the decade from 1880 to 1890. This view is supported by the known increase of electric street lighting during these years. In 1880 the income from electric street lamps in Massachusetts was practically nothing. For the fiscal year of 1890 the value of electric street lighting was $776,986.18, and the sum paid for gas street lighting was only 42.1 per cent of this amount.

The lowest point reached in the number of gas street lamps was in 1896, when it fell to 11,693. Since that date the increase to 13,308 has hardly done more than maintain a constant ratio to the growing population.

Quite different from the declining use of street lamps has been the application of gas stoves. For the year 1887 the number of such stoves reported was only 2,378, while for 1900 the number was 95,547. That is, during thirteen years the number of stoves reported has grown to more than forty times the original magnitude. In the seven years from 1887 to 1894 the number of stoves increased to 15,877, the average yearly addition being nearly equal to the original. During this period the reports seem to be incomplete, as figures for various large companies, notably those in Boston, were omitted. Beginning with the fiscal year of 1895 the returns seem to include nearly all important companies, and the number of gas stoves goes up to 42,563, or more than two and one-half times the reported number for the previous year. Of the stoves included in the report for 1895, 23,881, or a little more than one-half, were at Boston. Near the close of the fiscal year of 1894 one of the Boston companies, under the spur of competition, offered gas stoves to its customers on very favorable terms. This action no doubt had much to do with the large increase of the number of stoves at Boston in 1895 and 1896. How many stoves were put into use at Boston from 1894 to 1895 cannot be stated, but from 1895 to 1896 the number was 25,729, or more than the entire number there in 1895. During the year just considered, the number of stoves throughout the entire State, including those at Boston, increased from 42,563 to 72,195, or 29,632. It follows that the stoves added throughout the State outside of Boston numbered only 3,903, or less than one-sixth of the increase in that city. In 1896 the severe competition at Boston came to an end, and the maximum number of gas stoves there was reached in the fiscal year of 1897, when it stood at 53,350. Since the date just named this number has declined, and stood at 48,064 in 1900. At the time of severe competition stoves were installed at Boston without any charge and under contracts that titles should pass to the users when gas to a certain value had been consumed. The small decrease in the number of gas stoves used at Boston is probably due to failures of some consumers to burn enough gas to earn the stoves. Evidently the number of stoves in Boston had been pushed much beyond the normal demand.

Outside of Boston the increase has been constant and rapid, from 22,585 in 1896 to 47,483 in 1900, thus more than doubling in four years. This increase is the more instructive because it has come about simply through the natural demand. In 1897 Boston had 67 per cent of all the gas stoves in the State, but in 1900 this had fallen to 50 per cent. Boston still has four times as many gas stoves per unit of population as the remainder of the State, since its number of inhabitants is only one-fifth of that for the entire State.

Our Car Shortage.

Reports of car shortage rarely fail to put in an appearance at some time during the season of active shipments, either in the grain or coal producing sections, or wherever there happens to be an extraordinary pressure of traffic. From this fact the inference has frequently been drawn that the railroad companies, despite the additions made in recent years to rolling stock numbers, are far from having brought their equipment up to that condition conducive to the best economy in operating results. Naturally, the lack of cars or engines for tonnage actually offering means loss at some point or other; but still it seems that there must be the periodical outcry of a scarcity of cars. Just now it appears to be the iron and coal interests of Pittsburg and its vicinity which are the main sufferers, the car famine being characterized as the most serious Pennsylvania has ever experienced, says the New York Times.

It is perhaps not to be wondered at that there should be a lack of facilities such as are alluded to, seeing to how great an extent traffic has grown, and how little, apparently, has been done to meet this growth by adequate additions to the number of cars in the railroad service. A recent feature of railroad reports has been the amounts appropriated from earnings or raised by capital issues for the purpose of remedying this state of affairs by the reconstruction and enlarging of old cars and the building or purchasing of new ones, but the work has progressed on a very small scale compared with what traffic conditions indicate should have taken place, and the result is a state of affairs which at times is unsatisfactory to the last degree.

It may be urged, and properly so, that what additions have been made to freight equipments have to a great extent been cars of large capacity, much larger than that of cars destroyed or retired from service.

Take for example the equipment of the Chicago and Northwestern, upon which there have been quite liberal outlays the past few years, and it is shown by the company's reports that while the tons moved since 1898 have increased in the equivalent of 28 per cent, and the ton miles 22 per cent, freight cars of all descriptions have increased only 16 per cent, that is as to number, capacity not being ascertainable. Even this is a much better showing than could be made by the average railroad, large and small, a fact which is clearly brought out in statistics published which cover the country's entire railroad system. These, indeed, indicate really surprising conditions, and anything but adequate attempts to raise car numbers to the level of traffic development, strange as it may seem, after what has been the burden of so much talk of activity in car building, of bringing equipment up to date, and so forth.

Adopting results as set forth in the Interstate Commerce Commission's returns for the fiscal year 1900, and comparing these with results for previous years, the following somewhat striking comparisons are obtained, showing tons of freight carried and the number of cars in the freight service:

	Tons Carried.	Cars in Freight Service.
1894	638,186,553	1,205,169
1895	696,761,171	1,196,119
1896	765,891,385	1,221,887
1897	741,705,946	1,221,730
1898	879,006,307	1,248,826
1899	959,763,583	1,295,510
1900	1,101,680,238	1,365,531

The movement in freight is seen to have grown from 638,186,553 tons in 1894 to 1,101,680,238 tons for 1900, indicating that there was an increase of about 463,500,000 tons, or 72 per cent. If the enormous figures relating to the movement of tons one mile, the unit of service, be adopted, the result is quite similar, these showing in round numbers 141,599 million ton miles for 1900 against 81,073 millions for 1894, an increase of 60,526 million ton miles, or 74 per cent. But coming to the freight car equipment, it is to be noticed that 1,365,531 cars in 1900 took the place of 1,205,169 in 1894, the increase being 160,362 cars, or but little more than 13 per cent.

The Interstate Commission has succeeded in introducing into its reports statistics showing the number of tons of freight originating on all the roads, that is, avoiding all duplications owing to much of the tonnage passing over more than one road and being reported by all roads handling the first offerings. These, however, go no further back than 1899, thus limiting comparison to results for 1900 with those for that period. The number of tons given is 593,970,955 for the latter year, and 510,079,200 for the former, from which it can be seen that a net increase of nearly 84 million tons took place, or the equivalent of 16 per cent. Attention may now be directed to the fact, as demonstrated in the table, that 1900 showed a larger increase in cars than any other year, namely, 70,021 cars, but as this is less than a 6 per cent expansion, it will be at once realized that even on this exact basis the disparity between traffic gain and the furnishing of increased facilities is very great. A test of the tonnage movement on the basis reported for the longer series of years shows that between 1899 and 1900 the increase was very similar to that brought out the other way—that is to say, the actual tons without duplications—it being equal to about 15 per cent, so that comparisons are not vitiated by the different methods of making returns. This being the case, some idea may be gained of the increased demand for service put upon car equipment from a glance at the calculations now submitted giving tons carried per car for the past seventeen years:

	Tons per Freight Car.		Tons per Freight Car.
1894	529	1898	704
1895	582	1899	741
1896	626	1900	807
1897	607		

After such a showing as this there will perhaps be little wonder expressed that cars should run short when there is a press of traffic.

The Rapid Transit Subway in New York will be equipped with the third-rail system.

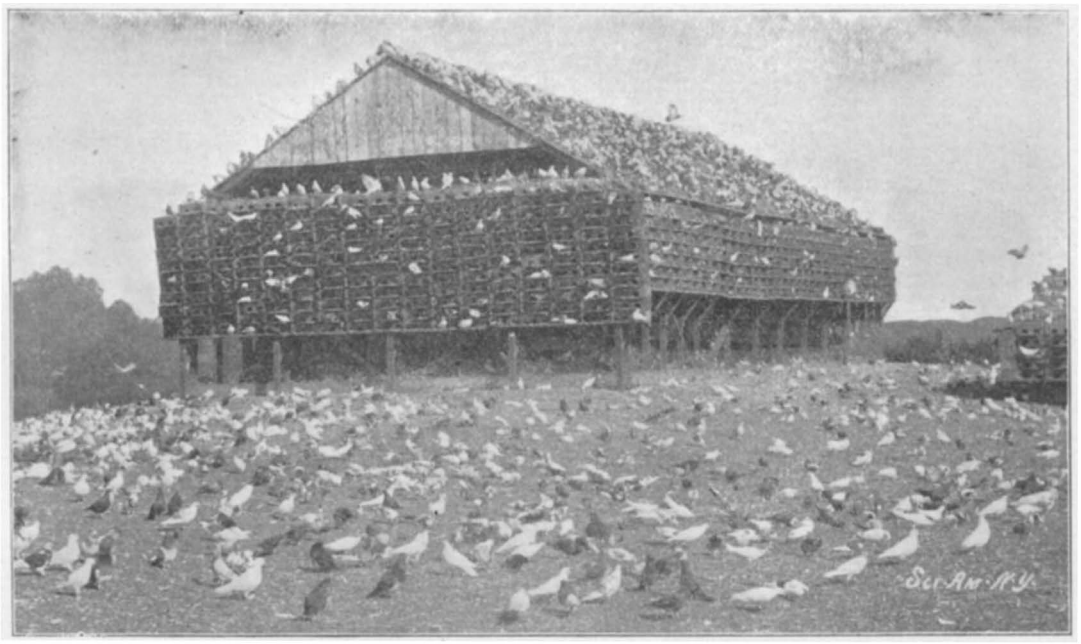
A PIGEON RANCH.

BY CHARLES F. HOLDER.

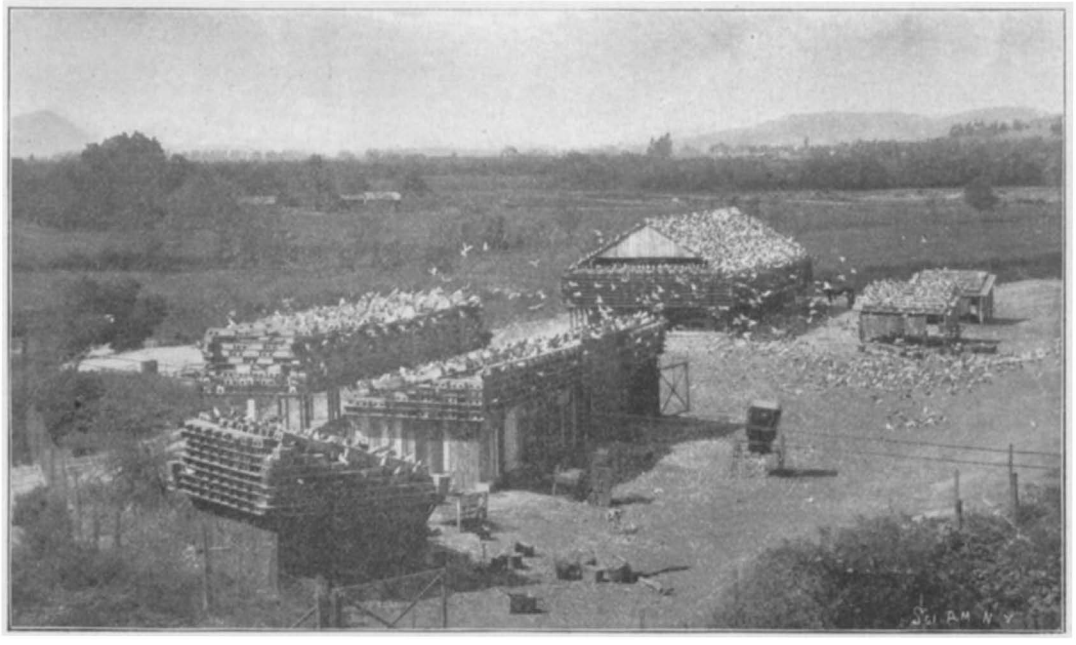
Travelers from Los Angeles to Pasadena, Cal., as the train winds up the Los Angeles River to enter the picturesque Arroyo Seco, at the head of the San Gabriel Valley, are sometimes entertained by the spectacle of vast flocks of birds which come sweeping on like huge flecks of brilliant summer clouds. In their beautiful movements they call to mind the famous flocks of Modena, which a century ago were not only one of the marvels of Europe, but of the world. For centuries the inhabitants of Modena had been pigeon trainers and fliers, and the sport became an art like falconry. The men who conducted it took their positions in tall towers, and by means of flags directed the movements of their flocks, some of which were all dark birds, others white or blue. The original pigeon fliers fought their flocks; that is, a flock was trained to dart into another, knives being attached to their feet. Sanguinary contests were carried on in midair, and when the flocks came together silvery bodies and feathers dropped, telling of the slaughter done. But the fliers of later days merely strive to develop beautiful figures and evolutions and to show the perfection of training.

Nowhere in the world, in all probability, can so many tame pigeons be seen in the air at one time as in or near Los Angeles. The great flocks which sweep down the Arroyo fairly cloud the sky at times when one stands in the well-wooded portion. The birds are then returning from some feeding ground, and if followed they can be traced to possibly the only pigeon ranch in America, shown in the accompanying illustration. Looking at it the reader can see at a glance about fifteen thousand pigeons, assuming that the birds are all at home, this being the estimated number on this unique ranch, owned by Mr. T. G. Johnson, of Los Angeles.

Southern California is particularly favorable to pigeons. They have few natural enemies, hawks being very scarce, while the perpetual summer is an important factor. The ranch was started some years ago by a man who believed that the squab supply was not equal to the demand, and he continued until he had accumulated several thousand birds, upon which he sold out to the present owner, who made a study of the question, and entered into it with the same zeal that an orange grower would. As a result Los Angeles has a ranch which is a curiosity in itself, ranking with the ostrich ranch which has been described in these columns.



A PIGEON LOFT ACCOMMODATING THOUSANDS OF BIRDS.



GENERAL VIEW OF THE LOS ANGELES PIGEON RANCH.

The pigeon ranch covers about eight acres of sandy, gravelly ground in the bed of the Los Angeles River, where there is an abundance of water. Here stands the enormous ark-shaped loft, or pigeon house, whose crudities of architecture are concealed by the thousands of pigeons which stand billing and cooing, upon the roof. Fifteen thousand birds fairly cover the ground and loft, so that at times from a distance it appears as though some of the snow from the neighboring Sierras had been dropped upon the roof. The increase of this gigantic flock is enormous, as may be assumed. If the market should fail, or give out, as did that for the Belgian hare, Mr. Johnson would be utterly unable to feed his birds, as in less than two years he would by calculation have a possible million birds on his hands. Fortunately, the demand is better than the supply, and the pigeon ranch sends about forty thousand squabs per year to the market.

The birds which produce this enormous output are well cared for, the conditions being all but perfect. The main building is sixty feet in length and twenty feet high; the exterior and interior being covered with mating boxes, on the outside standing in tiers of ten. In all there are between five and six thousand nests, all of which are so arranged that they can be reached by aisles or avenues from the interior, fumigated, cleaned, etc.

A rapid evolution is going on in the flock. Mr. Johnson desiring white birds, is eliminating the dark ones by selling them, and as a result the flock is rapidly becoming white, when it was quite the reverse last year. This change is well shown in the illustration. The statistics of this unique ranch are interesting. The estimated output for the month is three thousand, the gross income being about nine thousand dollars per annum. The average price per dozen for the birds is about three dollars, sometimes ranging up to ten. The expense of maintaining such an enormous flock is not inconsiderable, as, contrary to what might be supposed, the pigeons do not forage and fly far afield to feed, rarely leaving their home, thus forcing their owner to keep them in good condition. To accomplish this the birds are fed three times a day, each meal costing approximately for all, five dollars, so the annual food bill is about fifty-five hundred dollars. The food consists mainly of wheat, screenings, boiled meal and stale bread. The daily consumption is about twelve sacks of screenings, eight sacks of wheat and many gallons of boiled meal. The bread is an additional fattener given during the week.

Being conducted on scientific principles, the sanitary condition of the birds is excellent. Once a week every corner of the great building is disinfected by forcing carbolic acid and water into every crevice, while the nests are treated to a compound of sulphur and insecticide which keeps them free of parasites. Hundreds of pounds of straw are used by the birds annually for nesting purposes, which is scattered on the ground in the morning by the men and soon carried away by the nesting birds. No more interesting place in which to study the habits of pigeons could be imagined, as here every peculiarity of the bird, and all its stages from the egg to death from old age and the various diseases the pigeon is heir to, can be observed. The male birds select a single mate and are constant. Young birds begin nesting when they are between five and six months old; and when two eggs have been deposited the hatching season begins, ending in eighteen days. The pair divide their time in this duty, though the female has the greatest burden, being virtually relieved several hours a day.

The young birds are fed by the mother with the "pigeon's milk" of fancy for a while, soon eating grain, and in less than a month have passed the various grades of "peepers," "woolies," "squealers," given them by various owners, and become squabs and marketable. The squab belongs to the class of game birds that can be eaten continually, differing from quail and grouse and birds of more pronounced individuality; hence the public does not tire of them, and the supply is never quite up to the demand, at least in Southern California, shown by the fact that despite the enormous output squabs are still in the class of luxuries.

Mummies of Birds Examined at Lyons Museum.

More than a thousand mummies of birds sent from different parts of Egypt by Prof. Maspero have been opened at the Lyons Museum. A considerable number of these contained only the remains of very young birds, débris of feathers and bones, but it was possible to obtain and study the skeletons of more than 500 birds, which were well preserved. Some of these were in such a perfect state of preservation that they were recognized by a simple examination of the feathers, but most of them were determined after the skeleton. The mummies form two classes of a distinct appearance. The first includes the ibis and the second the birds of prey. The mummies come from the tombs of Sakkarah, Roda, Kom-Ombo, Gizeh and others. At Kom-Ombo they are of the Roman epoch and at Gizeh of the Ptolemaic. The birds of prey are mummified either singly or in masses of twenty to thirty, or even forty of all species. The single birds, eagles, hawks, or falcons have been generally plunged in a bath of liquid bitumen and then wrapped in bands of cloth. This gives them a form resembling that of human mummies. The birds of prey which are mummified in groups have the form of a cigar-shaped bundle from four to five feet long and sixteen inches wide. The birds have not all been mummified fresh, but some bear the traces of an advanced decomposition. No doubt such a great number of birds of prey could not be secured in one day nor by one person, but it is probable that they were brought one by one and at several days' interval by the inhabitants of the same village. When each had brought his offering, the package was made up with a bird of prey placed in the middle, accompanied by another kind of bird such as a cuckoo or several swallows, and sometimes a crocodile's tooth was added. The whole was then sprinkled with bitumen, then tightly wrapped in wide bands of cloth. Upon this were laid a number of long palm rods about the thickness of the finger, equally disposed all around, to give stiffness, and over this came the last wrapping of cloth. The offering thus prepared was carried in the neighborhood of the temple whose divinity it was desired to conciliate. As to the mummies of the ibis, these were always prepared with a single bird, wrapped in cloth bands or preserved in rough vases of red terra-cotta. In the former case the mummy was covered with a network of threads which were interlaced so as to form different ornaments. In other cases the ibis was wrapped in simple bands without ornamentation, but the head, instead of being placed in its natural position, is bent down upon the breast-bone and the long curved beak reaches to the feet. Some of the mummies which have externally the form of an ibis, and especially those with thread ornaments and two colors of cloth, light and dark brown, are counterfeits, and the interior is filled with all kinds of material, rags, pieces of wood, or feathers, with two or three pieces of brick to make up the weight.

Each station on the Manhattan Elevated Railroad is to be lighted by fifty lights of 12 candle power each; 35,000 incandescent and 250 arc lights will be used on the different stations. This improvement is greatly needed, as the stations have been very badly lighted for a long time.

RECENTLY PATENTED INVENTIONS.

Architectural Inventions.

ENTASISOGRAPH.—GEARY KIMBRELL, Pendleton, Ore. The invention provides a novel instrument which accurately draws the entasis of a classic column of the Ionic, Corinthian or Doric order. By the aid of this instrument any draftsman can execute his task more perfectly than an expert artist, at a considerable saving of time.

HEATING AND VENTILATING APPARATUS.—JOHN M. MILLER, Baldwin, Kans. Mr. Miller has devised an improved heating and ventilating apparatus which is designed to furnish the rooms of buildings with fresh air from out of doors, heated to a suitable temperature. The stagnant or dead air is carried away from the rooms so that the fresh air admitted is breathed pure and uncontaminated.

BUILDING SUPPORT.—MATTHEW H. CALLIHAN, Aspen, Colo. To provide means for supporting a long section of wall, by one device, thus avoiding injury by the use of independent supports, is the purpose of the present invention. To attain this end the inventor employs a bar, carrying a number of hooks arranged to underly the wall or other structure. The bar is carried by jacks which sustain the weight of the wall.

Engineering Improvements.

SLIDE-VALVE GEAR FOR ENGINES.—SAMUEL S. YOUNGHUSBAND, Granville Terrace, Woodlands Road, Darlington, England. In this valve-gear motion is transmitted from the reversing or expansion link to the slide-valve through an intermediate lever having a pivotal connection with the die-block of the link. The lever is connected by its shorter arm with the valve-rod, and is suspended by its other arm from a hanger on the weigh-shaft. The operation of the intermediate lever and connected parts is such that, with a given throw of eccentric, the travel of the valve is increased, whereby the admission and cut-off are more sudden, since they occur when the valve is moving at a higher speed than would otherwise be the case.

SPARK-ARRESTER.—GEORGE F. MOORE, Jr., General Delivery, New York city. When steam-engines are used in harvest-fields, the danger of setting fire to the straw or grain from escaping sparks is great. The present invention comprehends a simple and practical device for preventing such fires, which device is comparatively cheap and can be applied to the stack of any steam boiler furnace. The invention is a spark-arrester of a form employing a water spray above the smoke-stack flue.

Mechanical Devices.

ICE-CREAM FREEZER.—EDWARD R. MORSE, Birmingham, Ala. The ice-cream is frozen in a series of cups horizontally mounted in an ice-receptacle. By turning a crank the receptacle is swung first in one direction and then in the other. Since the cups are different distances from the center, the ice will be thoroughly agitated, with the result, according to the inventor, that the ice cream will be found thoroughly frozen in eight or ten minutes.

PIPE-WRENCH.—FRANK I. WEBBER, Oxford, Neb. The wrench comprises a handle, carrying a pivot on which a pair of interlocking jaws are held. A chain on the pivot is adapted to engage the pipe in conjunction with the jaws. The pipe is thus securely gripped and can be positively turned to the right or to the left without removing it from the wrench.

GRAPPLE.—MATTHEW H. CALLAHAN, Aspen, Colo. It is the purpose of this invention to provide an improvement in grapple or lifting-tongs, adapted for gripping and carrying various objects. The invention is embodied in two allied forms. In the one, two handle-bars or levers are connected with the shanks of the jaws or hooks composing the grapple proper, and are supported at one end by means of a rotatable wheel. In the other form, the levers are similarly attached to the hooks, but are adapted to be held and supported manually at both ends.

FIRE-LADDER AND ESCAPE.—PIETRO BASTIANELLO, Perth Amboy, N. J. The invention relates to extension ladders. The wagon or truck carries supports, pivotally connected ladders, and a turntable to which the lower ladder is secured. A grappling-iron on the upper end of the upper ladder provides a topmost support. A windlass and a cable connected with the heel portions of the ladders are used to operate the ladders. In addition to the ladders a cage is to be employed for the escape of persons from a burning building.

Machine Tools.

CUTTER-HEAD.—SAMUEL MACD. LANGSTON, Philadelphia, Pa. The cutter-head is of the type used upon a rotary shaft for the purpose of cutting thin material (tin plate, brass, and the like) in rolls or sheets. The cutter-head comprises a split-ring provided with bearing lugs and having normally free ends. An annular cutter is rigidly secured to the split-ring at a number of points, but leaving one of the ends free to move. A screw actuates the movable end relatively to the other end

PUNCHING-MACHINE.—FRANK F. CUMMS, Rutland, Vt. The punching-machine has a spring-pressed bar mounted to slide and arranged to carry a punch. A revoluble tappet-sleeve having tappet-fingers of different lengths causes the downward movement of the bar. Means are provided for adjusting the sleeve transversely to bring one or more of the tappet-fingers in operative position relatively to the punch. The device is simple in construction and very effective in operation. It is to be used especially for punching holes in straps.

SPOKE-THROATING MACHINE.—DEFIANCE MACHINE WORKS, Defiance, Ohio. This new machine is the invention of Mr. Charles Seymour, on whose work in improving woodworking machinery we have frequently had occasion to comment. This new machine is designed for the use of spoke, wheel, and wagon manufacturers, and is arranged rapidly, smoothly, and accurately to form the throat at both sides of the spoke during its passage through the machine. The construction is such that large or small spokes of any pattern in large quantities can be handled in a short time.

Printers' Machinery.

PRINTING-PRESS ATTACHMENT.—ROBERT NAUMANN, Manhattan, New York city. The invention provides improvements in ink-supplying attachments for printing-presses of the type having a rotary ink-spreading disk. The ink-font can be quickly attached to or removed from the press, so that different inks or changes from one color to another can be made without delay. By means of a simple device actuated by a movement of the press, the ink supply for the rollers will be forced out evenly and with uniform pressure. The amount of ink discharged in a given time can be nicely regulated.

SHEETING ATTACHMENT.—MICHAEL A. DROITCOUR, Pittsburg, Pa. The present invention is concerned with the delivery mechanism of printing-presses. The inventor has devised a new sheeting attachment which is arranged to take the printed sheets from the printing-press and wind them up in an apron or web without one sheet's touching or offsetting on the other, in order to allow the sheets to dry properly to prevent their being soiled, which only too frequently happens when the sheets are piled by the fly upon the fly-table. The inventor has assigned his patent to Mr. Gustav F. Kalkhoff, 409-415 Pearl Street, New York city.

Railway Appliances.

RAIL.—GEORGE A. CASE, Joplin, Mo. The principal feature of the rail lies in a novel structure by which one is enabled to provide in a practical manner a rail-ball which is removable from the web and base of the rail. The merit of this invention is that when worn out the rail-ball can be renewed without disturbing the other parts.

Designs.

BACK FOR BRUSHES.—LOUIS B. PRAHAR, Brooklyn, New York city. Mr. Prahar has designed a brush of novel shape and attractive ornamentation.

ALPHABETS.—MARCUS T. GOLDSMITH, Manhattan, New York city. The invention relates to a design for an alphabet to be used for decorative and advertising purposes.

SHOE-SOLE.—JOHN S. BUSKY, Brooklyn, New York city. The leading feature of the design consists in a rib extending longitudinally of the shank and in ribs extending transversely.

BRUSH OR MIRROR BACK.—WILLIAM W. BROMHAM, Manhattan, New York city. Mr. Bromham has tastefully ornamented the back of his brush or mirror with poppy flowers.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

AMERICAN BUSINESS AND ACCOUNTING ENCYCLOPEDIA. Compiled by E. H. Beach and W. W. Thorne. Detroit: The Bookkeeper Publishing Company, Ltd. 1901. Quarto. Pp. 1100. Leather binding. Price $8.

The volume is as portly as the time-honored dictionary, and it should prove as useful to all those who are interested in accounting. The amount of information which is conveyed in this volume is vast, to say the least. The number of examples of books of all kinds is most comprehensive, and the information is all given in language which can be understood by everyone. All classes of accounts are treated. Indeed, there seems to be hardly a business upon which this elaborate volume does not touch. The "Bookkeeper" is well known as a medium for the interchange of ideas among accountants, and there is no doubt that the excellence of the present volume depends to a considerable extent upon the knowledge which the editors have obtained while working upon this publication. In all there are 800 illustrations of special forms. Every bookkeeper and business man should obtain a copy of this valuable standard work upon bookkeeping and accounting. It is a treatise which we can thoroughly recommend.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 2035.—For manufacturers of gasoline engine castings.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 2036.—For parties to manufacture an invention on a bicycle sprocket.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 2037.—For parties to make steel vices.

Specialties wanted. R. H. Laird, 24 S. 7th St. Phila.

Inquiry No. 2038.—For dealers in pocket knives with microscopic views in handle.

Stencil Machines.—A. J. Bradley, 101 Beekman St. N.Y.

Inquiry No. 2039.—For makers of feather and artificial flowers.

Metal substitute. Crane Bros., Mfrs., Westfield, Mass.

Inquiry No. 2040.—For machinery for pitting prunes.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 2041.—For parties engaged in metal casting.

Sheet metal stamping and light manufacturing. Forskell Motor Co., Anderson, Ind.

Inquiry No. 2042.—For manufacturers of acetylene gas burners and fixtures.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2043.—For makers of generators.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 2044.—For parties making motor tricycles.

Sheet, bar, rod or wire, cut, formed, any shape. Metal Stamping Company, Niagara Falls, N. Y.

Inquiry No. 2045.—For makers of glass novelties.

For sheet metal stampings and novelties try Standard Stamping Co., Seventh and Hudson, Buffalo, N. Y.

Inquiry No. 2046.—For the makers of "The State Registered" gas stoves.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 2047.—For manufacturers of ligonier silicate bricks.

Are you looking for anything in bent woodwork? Write Tucker Bicycle Woodwork Co., Urbana, Ohio.

Inquiry No. 2048.—For manufacturers of crude oil burners.

Machinery designed and constructed. Gear cutting. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N.Y.

Inquiry No. 2049.—For oil burners adaptable for cooking and heating stoves and furnaces.

We build special automatic machines and devices. Preparing inventions for the market. Amstutz-Osborn Co., Cleveland, O.

Inquiry No. 2050.—For manufacturers of voting machines.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 2051.—For manufacturers of heavy hydraulic machinery.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2052.—For makers of coin vending machines of all kinds.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2053.—For an apparatus for making copies like original handwriting in black.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 2054.—For a patented machine for making a staple artic e.

Inquiry No. 2055.—For manufacturers of low-priced domestic hand sewing machines.

Inquiry No. 2056.—For a cheap outfit of ordinary block photo-process printing.

Inquiry No. 2057.—For manufacturers of goods suitable for tropics.

Inquiry No. 2058.—For makers of turbine water wheels.

Inquiry No. 2059.—For makers of equipments for a crematory.

Inquiry No. 2060.—For makers of frictionless metal.

Inquiry No. 2061.—For makers of furnaces for garbage or crematories.

Inquiry No. 2062.—For manufacturers of machinery for making buttons from mussel shells,

Inquiry No. 2063.—For manufacturers of ice machinery. (Kansas City or Chicago firms preferred.)

Inquiry No. 2064.—For manufacturers of compressed air carpet-cleaning machinery

Inquiry No. 2065.—For a separator for preventing the passing of dirt through a 6-inch steam pipe.

Inquiry No. 2066.—For an ice manufacturing plant with a capacity of 25 tons per day.

Inquiry No. 2067.—For manufacturers of a hydraulic wheel for rivers with a slow current to produce sufficient force to operate a pump giving 3 to 6 gallons of water per minute.

Inquiry No. 2068.—For manufacturers of canning machinery.

Inquiry No. 2069.—For dealers in spring steel 3x ⅞ and 1-16 thick.

Inquiry No. 2070.—For manufacturers of steel balls.

Inquiry No. 2071.—For wholesale dealers in large quantities of ⅛ or ¾ inch lead tubing.

Inquiry No. 2072.—For parties to make porcelain for sparking plugs for gas engine ignition.

Inquiry No. 2073.—For a spring power for running peanut roaster; motor to be about ⅛ to ¼ horse power.

Inquiry No. 2074.—Wanted, to purchase patents on articles suitable for general consumption, such as novelties, etc.

Inquiry No. 2075.—For a centrifugal extractor of gold ores.

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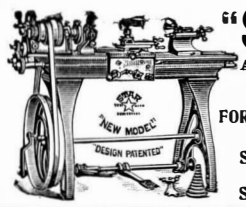

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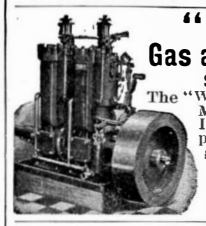

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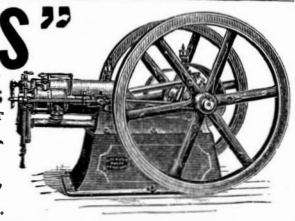

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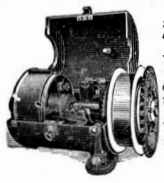

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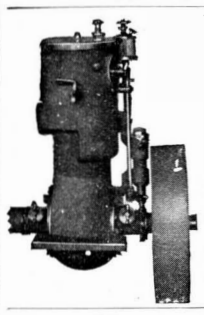

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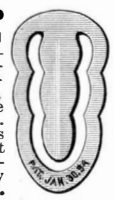

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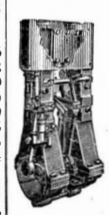

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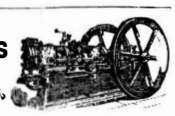

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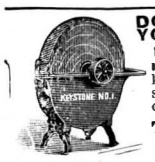

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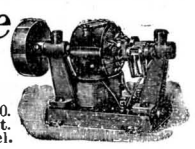

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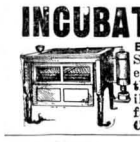

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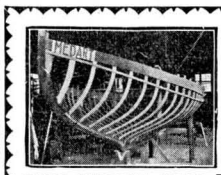

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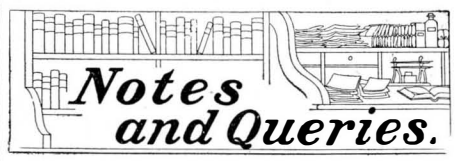

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(8524) J. D. Waite asks: Can it be proved that a right angle can be trisected? A. The trisection of a right angle is a very simple proposition. The radius of a circle is equal to the chord of 60 deg. If the radius be laid off as a chord from one extremity of the arc of a quadrant, or the arc subtending a right angle, and a radius be drawn to the other extremity of the chord, the angle formed on one side will be 60 deg. and on the other side the angle will be 30 deg. or one-third of a right angle.

(8525) A. E. N., Cape Colony, asks: Why do steam boilers explode when, through misfortune, a steamer sinks? A. The explosion of boilers in steamers that are wrecked is probably due to the sudden stopping of the engines and the abandonment of the fireroom by the firemen without the proper precaution to check the fires. It takes but a few minutes in such cases for the steamer to overbalance the outlet of steam from the safety valves, when the rise in pressure ruptures the boilers. When one explodes, others follow by damage from the exploded boiler.

(8526) G. J. R. asks: Can you give me the reason for the vibration in a motor or generator when the armature and shaft are balanced as nearly as possible? I would like to see what your opinion is in regard to it. A. The slightest excess of weight on one side will cause a perceptible vibration of an armature. As little as one-thousandth of the total weight will cause a very considerable vibration. If an armature is perfectly balanced, it will run so quietly that it is difficult to tell whether it is in motion or not. The process of balancing an armature is described in Crocker's "Electric Lighting," Vol. I., price $3 by mail.

(8527) C. H. W. asks in reference to the answer to query regarding the attraction of a 5-pound and 15-pound mass upon each other. The mutual attraction between the masses is given by the formula $F = K \frac{m\,m'}{d^2}$; and to this quantity the larger mass contributes three times as much as the smaller. It is true that this attraction acts upon both masses equally, and will give to each the same quantity of motion. In the case of the earth, when a body falls toward it, the earth also falls with the same quantity of motion toward that body. But the greater portion of the motion comes from the mass of the earth, since that is enormously greater than the mass of any body falling toward it, and therefore the small body moves much farther from this attraction than the larger one does.

(8528) H. L. B. asks: 1. Would you please tell me what produces the curly effect in bird's eye maple? A. We do not know how the mechanical forces act in the growth of the wood to produce the burls in the bird's eye. A while ago the question would have been answered, "It is the nature of the tree to grow that way." 2. Why is it necessary to only put ten 16 candle power 104-volt lamps on a circuit? A. The amount of current which is allowed to flow through one cutout in a building is regulated by the rules of the Board of Fire Underwriters and is determined by the risk of setting fire should a fuse blow.

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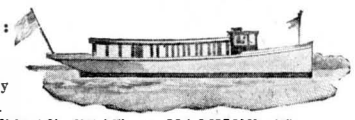

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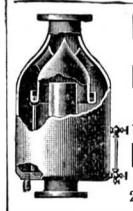

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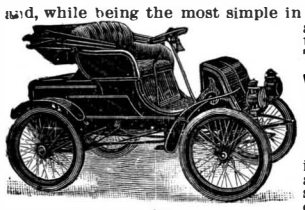

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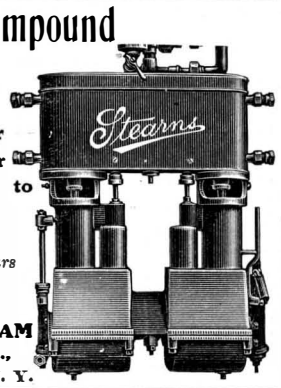

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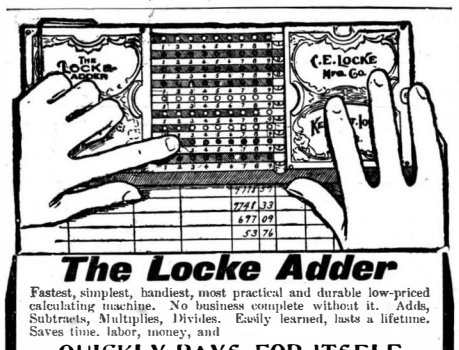

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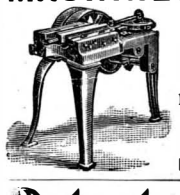

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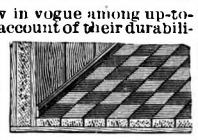

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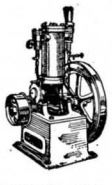

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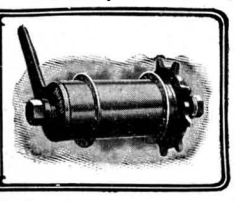

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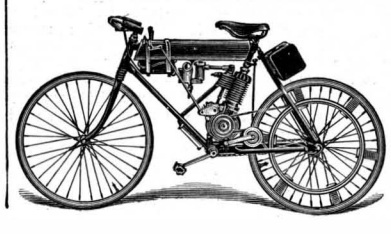

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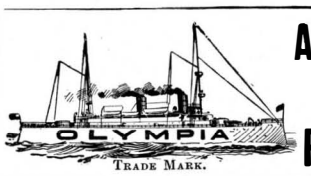

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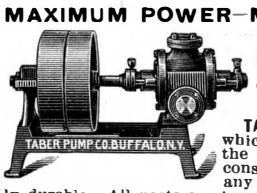

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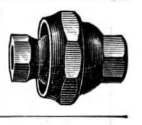

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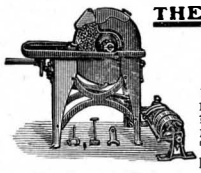

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